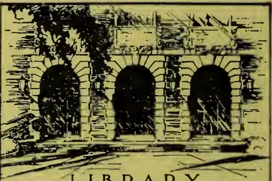
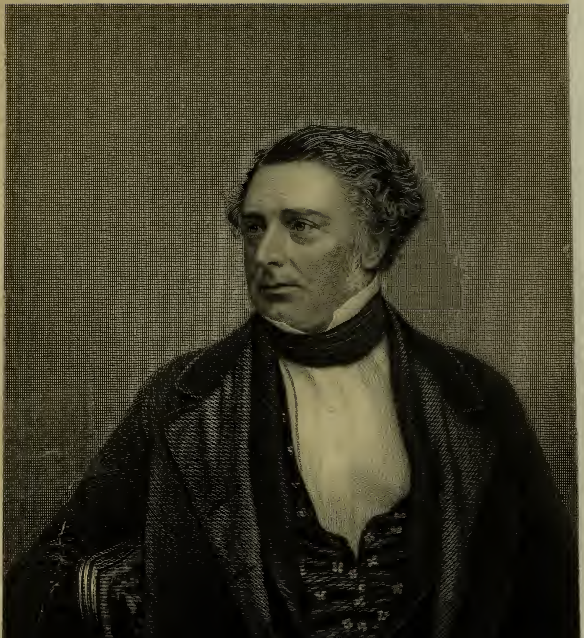




Rob Stephenson. F.R

Vice President of the
Institution of Civil Engineers;
M.P. &c
Inventor of the Railway Tubular Bridge.

THE

YEAR-BOOK OF FACTS

IN

Science and Art:

EXHIBITING

THE MOST IMPORTANT DISCOVERIES AND IMPROVEMENTS OF THE PAST YEAR,

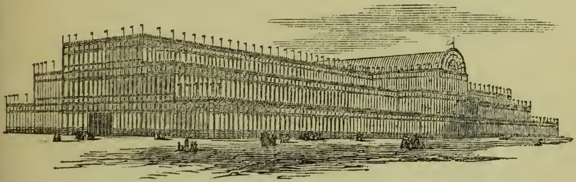
IN MECHANICS AND THE USEFUL ARTS; NATURAL PHILOSOPHY; ELECTRICITY; CHEMISTRY; ZOOLOGY AND BOTANY; GEOLOGY AND GEOGRAPHY; METEOROLOGY AND ASTRONOMY.

By JOHN TIMBS,

EDITOR OF "THE ARCANA OF SCIENCE AND ART."

Illustrated with Engravings.

"Those states which take no active part in the general industrial movement, in the choice and preparation of natural substances, or in the application of mechanics and chemistry, and among whom this activity is not appreciated by all classes of society, will infallibly see their prosperity diminish in proportion as neighbouring countries become strengthened and invigorated under the genial influence of arts and sciences."—Baron Von Humboldt.



The Building in Hyde Park, for "The Great Exhibition" in 1851: sketched from the west.
See page 7.

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ROBERT STEPHENSON, F.R.S., &c.

THIS distinguished Engineer, only son of the late George Stephenson, of Tapton House, Derbyshire, was born at Wilmington, near Newcastle-upon-Tyne, Nov. 16, 1803. He was educated at the academy of Mr. John Bruce, of Newcastle, which he left at the age of sixteen; and, after receiving, for a short time, private instruction in mathematics from Mr. Riddle, (now head-master of the Royal Naval School at Greenwich) Stephenson was apprenticed as a coal-viewer to Mr. Nicholas Wood; and served at his underground occupation for three years. In 1821, he entered at the University in Edinburgh; and, for a session, studied Natural Philosophy under Professor (afterwards Sir John) Leslie; Chemistry under Dr. Hope; and Geology and Mineralogy under Professor Jameson. In 1822, Robert Stephenson returned to Newcastle, and there commenced his apprenticeship to engineering, under his father, who had just established a steam-engine manufactory. After two years' laborious application, his health failed; in 1824, he took charge of a mining expedition to South America, and remained nearly four years in Colombia. On his way home in 1828, he visited New York, and Upper and Lower Canada, and took ship at Quebec for England.

Up to 1824, the period of Robert Stephenson's departure for South America, there were a dozen locomotives in use, and those were upon colliery trains; the only railways being the Stratford and Moreton, the first line opened for goods and passengers, as well as minerals, and the Stockton and Darlington, the one all but completed, and the other far advanced in construction. In 1825, Stephenson's old master, Nicholas Wood, published his "Practical Treatise on Railroads," the first complete work upon the subject. In 1826, the Liverpool and Manchester Line was commenced; and, on his return in 1828, Robert Stephenson found that great work nearly completed by his father, and his able assistant, Mr. Joseph Locke, now M.P. for Honiton. For the ensuing three years, Robert Stephenson devoted the greater part of his time to his father's locomotive manufactory; but worked also as an engineer, executing, in 1829, the Warrington and Newton, and Leicester and Swannington, lines. The motive power to be used upon the Liverpool and Manchester Railway had not yet been determined on; high authorities favoured fixed engines, George Stephenson and his son Robert, locomotives; when an able pamphlet, written by the latter and Joseph Locke, strengthened the Directors in favour of the last named engines. In 1829, they offered a premium for the best locomotive, which must consume its own smoke, must not, with its complement of water in the boiler, exceed six tons in weight, and must be capable of drawing after it, on a level and well constructed railway, a train of carriages, weighing 20 tons, at the rate of ten miles an hour. Four engines were entered for the contest, of which, however, only three appeared upon the rails; and of these, the Rocket, of Robert Stephenson, weighing 4 tons 5 cwt., and which, therefore, in accordance with the fixed terms, drew 12 tons 15 cwt., carried off the prize, put an end to the battle of locomotives and stationaries, and beyond measure raised the spirits of the Directors by accomplishing an average of 14 miles an hour, and attaining a maximum speed on one trip of 21 miles. This was the deciding point —to all practical purposes, the beginning of our present system of Railways.

Encouraged by this success, Robert Stephenson, with renewed earnestness, devoted his attention to locomotives, and accomplished numerous improvements: simplifying the working parts of the engine, increasing the steam-generating capacity of the boiler, and so varying the proportions of the several parts of the engine as to attain increase of power and speed. Each engine that month by month issued from the factory was an improvement upon its predecessors, until the 14 and 20 miles an hour of the Rocket were raised to 60 and even 70 miles; and the Newcastle factory became the largest and the most famous in the world.

Mr. Stephenson's next great work was the survey of the first projected line of Railway from London to Birmingham, in 1830-32, and the commencement of the works on June 1, 1834. The Belgian system of railways was next undertaken by George and Robert Stephenson, and was finished by the close of 1844. On completion of the London and Birmingham, they undertook the Birmingham and Derby, North Midland, York and North Midland, Manchester and Leeds, Northern and Eastern; and for the next ten years

Robert Stephenson was incessantly engaged upon the surveys, plans, and construction of various lines.

During this period, ROBERT STEPHENSON, as engineer in chief, executed the great iron cross of roads which unites London with Berwick on the one hand, and, on the other, Yarmouth with Holyhead; making, with the lines in connection with them, not less than 1800 miles of the entire iron highways of the kingdom.

At the general election of 1847 Robert Stephenson was returned to Parliament, without opposition, for the borough of Whitby, in Yorkshire, as a Conservative and Protectionist.

Of the works conducted to completion by Robert Stephenson, one of the greatest is the York, Newcastle, and Berwick line, with its magnificent High Level Bridge (with suspension roadway under the railway) over the Tyne at Newcastle, of which an Engraving appeared in the title-page of the *Year-book of Facts*, 1850. The Tweed Viaduct is another magnificent work on this line: it was opened August 29, 1850, by the Queen in person, who herself named it "the Royal Border Bridge."

But in magnitude of works, and conquest of difficulties, this line scarcely bears comparison with the Chester and Holyhead, (84½ miles,) also by Robert Stephenson; with its vast tunnels, viaduct, sea-walls, and avalanche timber galleries; and those miracles of engineering skill, the iron tubular bridges over the Conway and the Menai, the last of which was opened October 18, 1850. The construction of these Bridges has been, from time to time, reported in the *Year-book of Facts;* and in the present volume, at page 37, is given a paper on them, by Professor Cowper.

In admiration of these giant works, Durham College has presented Robert Stephenson with an honorary degree; and on the 30th of July last, his fellow-townsmen and friends entertained him at a banquet, to which upwards of 400 persons sat down, in the new Great Central Railway Station at Newcastle.

In addition to the works already named, Mr. Stephenson constructed the Florence and Leghorn line of about 60 miles, and has advised a system of railway for Switzerland. Besides his railway labours, he has been an honorary member of the Sanitary and Sewerage Commissions: and he has taken an active position in the arrangements for the Great Exhibition; more especially in his early encouragement of Mr. Paxton, in proposing his design for the Great Building in Hyde Park.

The accompanying Portrait is from a Daguerréotype, by Kilburn, Photographer to the Queen; and the substance of this brief Memoir is from an extended and able Biography in the *Illustrated London News*.

Robert Stephenson married, in 1829, Frances, daughter of John Sanderson, merchant of London. She died in 1842.

CONTENTS.

THE

YEAR-BOOK OF FACTS.

Mechanical and Useful Arts.

BUILDING FOR THE GREAT EXHIBITION OF 1851.

IN the *Year-book of Facts*, 1850, p. 13, we briefly announced the commencement of the arrangements for the "Great Industrial Exhibition of 1851." The proceedings of the past year (1850) to carry out this grand national project have been of the most interesting character, and even an abridged report of them would fill a large volume. All that we shall here attempt is to note the progress of the proceedings by date, and briefly to describe the vast Building which has been constructed for the occasion; reserving for a future occasion the details of the Exhibition itself.*

The year commenced auspiciously with the conferring of the national sanction on the undertaking, by the sign-manual of the Sovereign (Jan. 3); and the Royal Commissioners held their first Meeting on Jan. 11. On Feb. 13, Prince Albert presided over a joint meeting of the Committees; and next day, His Royal Highness sat as Chairman of the Commission. Within the month, meetings were held in the metropolis, in aid of the plan; and on March 21, the Lord Mayor of London invited the Mayors of nearly all the cities, boroughs, and towns of the kingdom, to a banquet at the Mansion House, to meet Prince Albert, who thereat lucidly explained the object of the Exhibition.

The First proposed Building.—The construction of a fit building for the Exhibition became one of the earliest subjects for the deliberation of the Committee appointed to examine the plans submitted in reply to the Commissioners' advertisement. The Building Committee comprises three leading architects,—Mr. Barry, Mr. Cockerell, and Mr. Donaldson; and three leading engineers,—Mr. Brunel, Mr. W. Cubitt, and Mr. Robert Stephenson; who met twenty times, before deciding upon their report. At length, they selected, from 240 plans, some 60 as supplying useful hints; the plan from which most advantage was derived being the work of a young architect at Islington. Founded on these, the Committee themselves prepared a plan, of which it may be sufficient to explain

* It is our intention to publish, as soon after May next as circumstances will allow, a SUPPLEMENTARY YEAR-BOOK OF FACTS, 1851; to be exclusively devoted to a *Descriptive Account of the Exhibition*, its object, scope, and character; preceded by a review of the origin and history of the Exhibition; the *Constructive Details of the Great Building*, more fully than at present; and a *Catalogue Raisonnée* of the principal articles exhibited.

that it was to be open; to be formed into three main divisions (with side branches) by iron (water-pipe) columns, the middle aisle being the highest; with a central dome of enormous diameter. The side walls were to be comparatively low; and the clumps of trees included within the area made available for refreshment places. The site of the building was to be on the south side of Hyde Park, between the Kensington-road and that part of the Park known as Rotten-row: this locality having been named from the first proposal of the Exhibition.

The building design gave little satisfaction, but was decided to be executed; the reservation being made, that *bonâ fide* tenders for any construction, offering greater advantages than that proposed by the Commissioners, would be considered. At this moment, a design for the building, to be principally constructed of iron and glass, proposed by Joseph Paxton, F.L.S., was accepted, with certain modifications, and the addition of a transept; and has been completed.

Mr. Paxton's Design, with the gradual development of the method of construction employed, is thus detailed in a paper read by him to the Society of Arts, Nov. 13, 1850:—

The author began by stating, that the Great Exhibition Building was the development and result of a very long series of experiments made by him at Chatsworth in the erection of the different horticultural buildings there, since the year 1828. The pine-house, built in 1833, was the first in which the ridge-and-furrow roof—an essential feature in the Great Building—was employed. This roof was contrived by Mr. Paxton so that the glass in it might be more nearly at right angles to the slanting and weak, though valuable, rays of the morning and evening sun than that in the straight roofs was. So well was it found to answer, that, in 1834, he built a greenhouse 97 feet 6 inches by 26 feet, with a mean height of 14 feet 6 inches: this building, even under the old glass-tax, cost only 2d. per cubic foot. It was followed in 1836 by a "curvilinear" hothouse, 60 feet by 26 feet, so called from the roof being a quarter circle: here the Victoria Regia first flowered in 1849. In the following year, the Great Conservatory was commenced; and in order to economise labour in its construction, Mr. Paxton invented a machine for forming the sash-bars, by which he effected a saving of £1400, and for which the Society of Arts, in 1841, gave him their silver medal. This has been the type of all the machines for wooden sash-bars since used.* For this building, sheet-glass was first made, by the Messrs. Chance and Co., of the length of 4 feet,—nothing beyond 3 feet having ever before been made. The Great Conservatory is 277 feet long, 123 feet wide, and 67 feet to the crown of its domed roof.

In a conservatory at Darley Dale, in 1840, Mr. Paxton first employed the ridge-and-furrow roof on a level; that is, neither curvilinear nor inclined, as in the former cases. The breadth of this building is 17 feet; and so successful was it that, in a letter from the proprietor, it was said to be constantly used as a sitting-room

* Transactions of the Society, vol. liii. pt. i. page 97.

by his family. This was more extensively carried out in the new Victoria Regia house, 60 feet 6 inches in length and 46 feet 9 inches in breadth, with a clear span for the roof of 33 feet 6 inches; and which, on its small scale, is a perfect type of the Great Building.

The time for receiving the designs for the Industrial Building had expired; but from the whole matter being already digested, and the system of ridge-and-furrow *flat* roofs so fully in Mr. Paxton's mind, it only required the adaptation of the principle on a large scale to suit the vast building for the Exhibition. His plans were got up in about ten days, and he had the satisfaction of their being ultimately approved of by the Commissioners.

"The design for the building was planned, first with particular consideration as to its fitness for the object in view, namely, the Exhibition of 1851; secondly, its suitableness for the site proposed; and lastly, with a view to its permanence as a winter-garden, or vast horticultural structure; or a building which might, if required, be again used at any future period for a similar Exhibition to that of 1851.

"One great feature in the present building is, that no stone, brick, or mortar, has been used, but the whole is composed of dry material, ready at once for the articles to be exhibited. By combination of no other materials but iron, wood, and glass, could this important point be effected; which, when we consider the limited period allowed for the erection of so stupendous a structure, may almost be deemed the most important object.

"It was unnecessary to cut down any of the large timber-trees, provision being made by means of a curvilinear roof over the transept for their reception within the building; and, by a proper diffusion of air, they will not suffer by the enclosure.

"The dimensions of the building are 1851 feet in length, and 456 feet in breadth in the widest part.* It covers altogether more than 18 acres; and the whole is supported on cast-iron pillars, united by bolts and nuts, fixed to flanges turned perfectly true, and resting on concrete foundations. The total cubic contents are 33,000,000 feet.

"The six longitudinal galleries, 24 feet in width, running the whole length of the building, and the four transverse ones of the same dimensions, afford 25 per cent. additional exhibiting surface to that provided on the ground-floor. This extra space is suited for the display of light manufactured goods; and from it a complete view of the whole of the articles exhibited, together with an extensive view of the interior of the building, will be obtained.

"The roof is built on the ridge-and-furrow principle, and glazed with British sheet-glass, as previously described; the sheets being 49 inches long, *i. e.* an inch longer than those of the Great Conservatory at Chatsworth. The rafters are continued in uninterrupted lines the whole length of the building. The transept portion, although covered by a semicircular roof, is also on the angular principle.

"The length of sash-bar requisite is 205 miles. The quantity of

* These and some of the following dimensions have been slightly varied.

glass required is about 900,000 feet, weighing upwards of 400 tons. All round the lower tier of the building, however, will be boarded, with fillets planted on in a perpendicular line with the sash-bars above.

"The gutters are arranged longitudinally and transversely: the rain-water passes from the longitudinal gutter into a transverse gutter over the girders, and is thus conveyed to the hollow columns, and thence to the drains below. As these transverse gutters are placed at every 24 feet apart, and as there is a fall in the longitudinal gutters both ways, the water has only to run a distance of 12 feet before it descends into the transverse gutters, which carry it off to the hollow columns, or down-pipes. The grooves for carrying off the moisture which condenses on the inside of the glass are cut out of the solid; in fact, the whole gutter is formed by machinery at one cut. The gutter is cambered up by tension-rods, having screws fixed at the ends, so as to adjust it to the greatest nicety, as is the case with the wrought-iron girders which span the Victoria Lily House.

"The boards for the floor are 9 inches broad and $1\frac{1}{2}$ inch thick, laid half an inch apart, on sleeper-joists 9 inches deep and 3 inches thick, placed 4 feet apart.

"This method of flooring possesses the following advantages:— It is very economical; dry, clean, pleasant to walk upon; admits of the dust falling through the spaces; and even when it requires to be thoroughly washed, the water at once disappears betwixt the openings, and the boards become almost immediately fit for visitors.

"The galleries are laid with close boarding.

"Ventilation has been most carefully considered, and a most copious supply of pure air is provided.

"Four feet round the whole of the basement part of the building is made of *louvre-boarding;* and at the top of each tier a similar provision of 3 feet is made, with power to add an additional quantity if required. In the centre aisle, also, the air will be plentifully admitted. By simple machinery the whole can be regulated with the greatest ease. The advantages of this kind of ventilation are several. Louvre-boards are very simple in construction. They can be opened and closed instantaneously with the greatest readiness. They nicely distribute the air, and yet admit a large volume of it; and, from the manner in which they are placed over each other, they effectually prevent the entrance of wet in rainy weather.

"A provision will be made for the India method of ventilation, if the heat is so intense as to render it desirable to have the temperature lower than out of doors.

"In order to subdue the intense light in so large a building covered with glass, all the south side of the upright parts, and the whole of the angled roof, will be covered outside with canvas or calico, so fixed as to allow a current of air to pass between the canvas and the roof; in very hot weather water may be poured on, which will very much assist in lowering the temperature within.

"This sort of covering offers the following advantages:—The

brightness of the light will be tempered and subdued; the glass will be protected from the possibility of injury by hail; the screen being on the outside will render the building much cooler than if it were inside; and the ventilation can then be regulated at pleasure.

"After the Exhibition is over, I would convert the building into a permanent winter-garden, and would then make carriage-drives and equestrian promenades through it. There would be about two miles of galleries, with two miles of walks upon the ground-floor, and sufficient room would be left for plants. The whole intermediate spaces between the walks and drives would be planted with shrubs and climbers from temperate climates. In summer the upright glass might be removed, so as to give the appearance of continuous park and garden."

The above paper was accompanied by a large number of drawings, views, and diagrams, and by one of the sash-bar machines. The most interesting illustration was a specimen of the leaf of the Victoria Regia, 5 feet in diameter, the growth of five days. The under side of the leaf presents a beautiful example of natural engineering in the cantilevers which radiate from the centre, where they are nearly 2 inches deep, with large bottom flanges and very thin middle ribs, and with cross girders between each pair to keep the middle ribs from buckling; their depth gradually decreasing towards the circumference of the leaf, where they also ramify.

Details of the Building, by Mr. M. D. Wyatt.—In a paper read to the Institution of Civil Engineers, Jan. 14, 1851, Mr. M. D. Wyatt, Assoc. Inst. C.E., showed the Building to consist of a nave 72 feet wide, and 64 feet high, with a series of side aisles, two of 48 feet and six of 24 feet wide of the respective heights of 43 feet and 23 feet; the whole spreading to a width of 436 feet.

A transept, 408 feet long and 72 feet wide, intersects the building at right angles in the centre; this transept is covered with a semicircular roof, springing at a height of 64 feet from the level of the ground, and making the entire height 100 feet.

The details of the construction were very minutely given; from the concrete filling of the holes in the ground, under each support, through the base-plate, the columns, 8 inches in diameter; the connecting pieces, to which are attached the girders for the galleries; the second and third sets of columns and the roof trusses, the box-gutters and the "Paxton" gutters, which latter are intended to provide at the same time for conveying away the rain from the roof, and the condensed moisture from the inside. The total area of the ground-floor is equal to 772,784 square feet, and that of the galleries to 217,100 square feet.

Details were also given of the mode of conveying the rain-water, &c., into the adjoining sewers, through the interior of the supporting columns; of the ventilation by means of sets of louvres, of galvanized cast iron, placed between the columns of the side aisles, and in the upper part of the roof; of the supply of water for the extinction of fire, and for the supply of the fountains; and of the

experiments for testing the girders and trusses, by the hydraulic press erected in the building, and by which the strength of the whole was proved before they were used.

In examining the power and dexterity with which the design had been realized by Messrs. Fox, Henderson, and Co.—or, in other words, in the construction of the actual building—it was necessary to bear in mind that their tender was only verbally accepted on the 26th of July, 1850; that possession of the site was obtained on the 30th of July; that the first column was fixed on the 26th of Sept. and on Jan. 14, 1851, (only 145 working days since the commencement) but little of the vast building remained to be finished. To give an idea of the huge size of this building, it was noticed that the width of the main avenue was within 10 feet double that of the nave of St. Paul's Cathedral, whilst its length was more than four times as great. The walls of St. Paul's were 14 feet thick; those of the glass building in Hyde Park were only 8 inches. St. Paul's occupied 35 years in building, whilst the Hyde Park building would be finished in less than half that number of weeks. The celerity of the construction was very remarkable. As many as 308 girders had been delivered on the ground in one week. Seven of the great trusses of the nave were raised in one day. Each man fixed about 200 superficial feet of glass per day.

In order to perform this work, it was necessary to devise and employ various contrivances for economising labour; such as the sash-bar machine, the gutter machine, the morticing machine, the painting machine, the glazing machine, besides many others of an equally ingenious nature,—all of which were described.

In the course of the paper, Mr. Digby Wyatt, (to whom, from the commencement, had been entrusted the active superintendence of the construction of the building,) paid a well-merited tribute of praise to Mr. C. H. Wild and Mr. Owen Jones, who had been associated with him; to Mr. Barry and Mr. Brunel, who, as members of the Building Committee, had made very valuable suggestions; as well as to Messrs. Fox and Henderson, and to Mr. Brounger, Mr. J. Cochrane, and others, for their exertions in the execution of the construction; and he concluded by reminding the members that the weight of responsibility, the arduous duty of supervision, the honour of acting as the master-mind, to weigh the requisites, to determine the design, and to govern the construction of this great apparatus, had been reserved for Mr. Cubitt, the President of the Institution of Civil Engineers.

The Scientific Construction illustrated by Professor Cowper.—On Dec. 31, 1850, Professor Cowper illustrated to the Members of the Society of Arts, assembled within the Great Building, its truly scientific construction.

First, as to the columns, which are not solid, as if of brick or stone, but hollow,—that is, tubular; and here science at once decides that this is the stiffest and strongest form for a given quantity of material. For instance, if we take two iron columns, each

30 feet high, the one being of 12 inches diameter, and hollow, with metal an inch thick, and the other being solid, and 6·63 inches diameter, we find that the former will sustain about four times the weight of the latter. This was illustrated by the Lecturer placing two pieces of quill in a vertical position between two boards, the upper one being adjustable by hinges, and then placing weights on the upper board just above the quills, until they reached 224lb., which was found to be the crushing weight. The columns throughout rest on concrete, composed of large stones mixed with 1-7th of sand and 1-7th of lime; the whole being incorporated with a sufficient quantity of water: the gravel is taken from pits sunk on the premises. An iron tubular socket, from three to four feet long, according to the levels of the ground, which differ throughout, and of the same diameter as the column itself, was placed upon the concrete when dry; the bottom of the socket, being very broad and flat, was firmly fixed to the concrete by cement. To fix the socket exactly in its right place, with regard to the rest of the sockets, was indeed a very nice point; and a repetition of this operation constituted, in fact, the "setting out of the building." A theodolite for marking the direction, a 24-feet rod to measure the distances, and wooden stakes, each having a nail driven into it, to mark the point corresponding with the centre of the respective columns, were required in the "setting out." When the concrete was put into the holes dug for its reception, the stakes were necessarily removed, and the socket was adjusted to its exact position by means of a triangular wooden frame, points in two of the angles resting on the nails of two stakes; the other limb having a semicircular end, to fit the outside of a contiguous socket already fixed in its place. Column covers column with as much truth as if their places were set out on a sheet of paper, instead of on an area of 18 acres of ground. The sockets being fixed in their places, the lower columns, 18 feet 8 inches high, were fixed upon them by bolts and nuts; then a connecting piece, 3 feet 4½ inches high; then another column, 16 feet 7½ inches high; then another connecting piece, and so on. In the usual way, the ends of these columns and connecting pieces would have been *chipped and filed;* but the 12,000 ends of the columns and pieces are here turned or *faced*, so that if the base of the socket be placed perfectly level, the columns and connecting pieces *must* stand upright; and not a crooked line is discoverable throughout the building.

The trellis girders were next illustrated. In a common arch we have the pressure, or thrust; while in a suspension-bridge, we have tension: in a girder, there is both the thrust and tension. In order to show that *form* has a great deal to do with the strength of materials, the Professor subjected a small sheet of tin to the pressure of his hand, and immediately doubled it up; but, on putting the same piece of tin into a tubular form, and subjecting it to the like pressure, it retained its shape entire under 2 cwts. He then analyzed a trellis-girder, showing its weakness without the addition of the braces,

by means of wooden models, and by the aid of laths pinned at the angles, and representing one-half of the transverse section of the building; then adding to the model, brads throughout. The extreme load which is ever likely to be placed on any one of the girders is 7½ tons; whereas every cast-iron girder is proved by the hydraulic testing machine to 15 tons, the breaking weight being 30 tons.

The almost entire absence of scaffolding was not the least curious part in the construction of the building. The fact is, the columns themselves formed the scaffolding; and, with the addition of a wooden pole or two, and a few ropes and pulleys, the whole of the columns and girders were fixed in their places.

The "Paxton" gutters, when first designed for the Chatsworth Conservatory, were cut out by hand; but this would have been too tedious a process for a building required to be executed in so short a time. Machinery was therefore contrived, by which the rain-water gutter in the top of the timber, and the two sloping "condensation" gutters, one on either side of the timber, were all cut out together.

The transept was introduced to give additional stiffness to the building, and its arched roof to prevent lopping the tallest tree. Iron would have been too heavy for the arch-ribs or principals—and wood was therefore used. Each rib is composed of four layers of planks laid flat upon each other, with curved planks on the inner and outer sides; a strong strap of iron runs along the inner and outer sides, and iron-screw bolts and nuts pass through the iron straps and the wood, binding the whole firmly together, making the arch stiff, and with so little tendency to spread, that, when the ends (by way of trial) were put on planks, and the arch loaded with a weight equal to that which it was intended permanently to sustain, the friction was found to be sufficient to keep it from moving. The Professor then loaded the model with 24 cwt., but without producing any change in its form.

The iron castings are by Messrs. Cochrane and Co., of Woodside Iron Works, and Mr. Robert Johnson, of Holly-hall Works, both near Dudley. Messrs. Tupper and Curr supplied the 11,000 plates of their galvanized iron of No. 18 Birmingham wire gauge, which constitute the louvers or blades of the ventilators.

At the conclusion of the lecture, Mr. Cowper explained, in order, the testing machine; Henderson's patent "derrick" crane; the punching and cutting machines; the machinery for cutting off the ends of the sash-bars, and forming the semicircular ends to the gutters; the drilling machine; the mode of painting the sash-bars by machinery; the glazing waggons; the construction of the transept, and other parts of the ingeniously-contrived edifice.

Illustrations by Mr. Fox.—Mr. Fox, the engineer, has illustrated to the Society of Arts, the following several provisions made in the construction of the building.

Damp.—Mr. Fox believes the building will be one of the driest

ever constructed; since it would always be acting on the principle of a still. Any exhalation that might arise from the soil underneath the floor would naturally rise till it came in contact with the glass at the top; on any alteration of the temperature it would be condensed on the glass, and must again trickle down by capillary attraction, and find its way to the small groove prepared on each side of the Paxton gutters, and then be eventually carried away into the sewer; so that any evaporation would never have the power of returning, because the moment it got condensed on the surface of the glass or sash-bars it could only escape through the gutters. The grooves not only took away the water, but, supposing a pane not to be sufficiently tight in the groove, any small quantity of water that might escape through the edge of the glass and get underneath, by the same principle of capillary attraction would find its way to the groove, and then pass away. The transept roof and the skylight bars were not only placed horizontally with respect to the vertical part of the arch —they were "herring-boned;" in fact, they were angular, both horizontally and vertically at the same time. So that in the transept roof, from top to bottom the same principle of capillary attraction was at work and provided for; and every skylight was arranged on a slope of $2\frac{1}{2}$ to 1, which is the same as in the horizontal roof.

Wind.—The building rested on 1,060 columns on the ground floor, and the most likely direction for the wind to have any injurious effect on the structure must of course be in the direction of its greatest width, which was 1,800 feet as compared with 400 in the opposite direction. These columns rested on cast-iron plates based upon concrete; and there was no possibility of their rocking about, without the base plates being broken. Above these plates were sleepers, that carry the floor. They were 13 inches in depth, and fitted accurately up against the two sides of the column, and running transversely from one side of the building to the other; so that it would be very difficult to conceive that one of these columns could be possibly upset until it was actually broken in two. And again, at the top the columns are united together by cast-iron girders three feet deep, and four columns are framed together, very much as a table would be framed. Now, to break the column, we must exert a force equal to that of twice the transverse strength of the column. According to experiments, it was found that six tons was the bearing weight, and twelve tons the breaking weight of the columns in the centre. Now, 1,060 columns multiplied by six tons, the bearing weight, was equal to 6,360 tons; so that it would be necessary to exert a force equal to 6,360 tons, at a height of 24 feet from the ground, before we should be able to blow down the building, and he was now treating of the building independent of its bracings. The greatest force of wind ever known had been computed at 22lbs. to the superficial foot. Taking 28lbs. as the force, and assuming that they could have a gust of wind which would strike the whole side of the building from top to bottom at the same moment, the total force which could be brought against it would be from 1,400

to 1,500 tons. Now the Building possesses a power to resist it of 6,360 tons; not taking into account the bracings and the other constructions and offices which were within the building, and which must of course add to its strength.

Expansion and Contraction.—Mr. Fox explained that the whole extent of the surface covered by the building, from centre to centre at each end, was 1840 feet, and the width of the general rectangle of the building 408 feet. The total difference in length of a cast-iron bar 408 feet in length between the extremes of summer and winter would be about $1\frac{1}{8}$ inch. The building was divided into two by the nave, which ran from end to end, the only connection between the two sides being the wrought iron trusses and the roof. The greatest difference in the total amount of motion in expansion or contraction which could by any possibility take place in the perpendicularity of the columns from the effects of a change in the atmosphere, would be about a quarter of an inch; while it would be perfectly safe to bend any of the columns to the extent of two inches at the least. The expansion and contraction are provided for by the elasticity of the columns themselves, which are all "keyed up" hard and fast together, for distances of 200 feet at each end of the building, and for a similar distance upon each side of the transept. The girders would have the opportunity of sliding upon the brackets which supported them. The flooring of the galleries, which run the whole length of the building, as well as the Paxton gutters which formed the girders, served as a continuous wooden tie, leaving the cast-iron in a condition to expand accordingly as it was acted upon by the various changes of the atmosphere.

Strength of the Girders.—It had been assumed that a crowd of persons densely packed would press upon the galleries with a force equal to that of 112 lbs. per superficial foot, which would bring upon each girder a load of somewhere about five and a half tons: they were proved to fifteen, and would not break with less than thirty tons.

Vibration of Machinery.—Mr. Fox said, that so little apprehension did he entertain on this score, that he proposed to have the bands of the machinery attached to the columns themselves; and should be happy to have a locomotive engine run along the gallery.

Lighting.—Unbleached calico placed over the building had subdued and tempered the light very agreeably.

Strength of the Glass.—Its thickness was very important, but the width was equally so. If they got a piece of glass of a certain thickness and width, and found that the hailstones broke it, let them reduce the width, and they would find that it would bear the force of the hailstones. Now the panes used in the building were 16 ounces to the foot, and 49 inches long and ten in width. If, instead of 10 inch width, it had been 15, it would be broken in the first hail-storm.

Provision against Fire.—The entire building was overlooked by windows at the exit of doors, of which there were 19 or 20; so that, in the event of fire, they could at once see any portion where it existed, and extinguish it. And for the purpose of obtaining a proper supply of water, the Chelsea Water-Works Company were constructing a 9-inch main, with a column of 70 feet constantly on it, and a 6-inch pipe running across the building; also a 6-inch pipe running round the whole of the outside of the building, together with sixteen branches from the outside pipe running into the interior; and by which, with one length of hose, and without the aid of a fire-engine, they would be able to control the whole surface of the building. A special arrangement had been made with the Chelsea Water-Works Company for the water to be always on; and the Company had been at the expense of an additional auxiliary engine for the purpose of ensuring a constant supply; whilst in ordinary cases they were bound to supply 300,000 gallons per day.

We conclude with a few miscellaneous details. All the dimensions of the Building are multiples of 8: for instance, the width and height of the smaller aisle is 3 times 8, or 24 feet; of the second largest aisle the width is 6 times 8, or 48 feet; and of the great centre aisle, 72 feet, or 9 times 8. The whole width is 408 feet. The transept was added to Mr. Paxton's design by Mr. Henderson, and its hemispherical roof by Mr. Barry, R.A. The span is 73 feet: the roof is a semicircle, with a radius, therefore, of half that dimension: it is 408 feet long, and is at the crown 108 feet from the floor. Prof. Cowper observes:—

"I look upon the original idea of Mr. Paxton as one of the most successful efforts of imagination and contrivance, and I consider the way in which Fox and Henderson have made the bold conception *practicable*, one of the most successful and astonishing examples of contrivance, tact, science, industry, and perseverance, and engineering skill, the world ever saw; and, whatever wonders may hereafter be placed in this building, the structure itself will be the greatest wonder of all."

THE UNITED STATES' MAIL STEAMERS "ATLANTIC," AND "PACIFIC."

These are the first two of the new line of Steam-ships, (called *Collins's line*), to run between Liverpool and New York.

The *Atlantic* is stated to be the largest steam-ship ever yet built, being 2,860 tons burthen.

A Correspondent of the *Mechanics' Magazine*, writing from New York, 29th of April, says with regard to this fine steamer:—

"On coming up the Bay, with 20lbs. of steam, cutting off on the expansion valve at one-half, and the throttle only two-thirds open, making 17 revolutions per minute, we ran from Fort Hamilton to the battery at New York in 28 minutes, second quarter of the ebb tide, which I take to have been 1½ minute against us, while the distance ran could not be less than 7¼ miles; so that the speed through the water was certainly not less *than seventeen miles per hour.*

"The *Atlantic* was calculated by the late Mr. John Farron to start at 14—

end with 18—average 16 revolutions per minute—to carry 18lbs. of steam, cut off at half stroke, and burn 5,000lbs. of coal per hour.

"The cylinders (two) are of 95 inches diameter and 9 feet stroke, combined power per Boulton and Watt 800 horses power, but really 2,250 horses power; wheels 34 feet 2 inches over paddles, which are 12 feet + 2 feet.

Calculation of Speed.—Wheels 32′ 2″ effective diameter, allowing 26 per cent. for slip, and the whole distance from New York to Liverpool at 3,600 statute miles, 16 revolutions per minute; or the distance in 11 days.

Cause of Speed.—544 feet of grate surface, and a very large amount of recipient heating surface in proportion to it, so as to need burning but 9lbs. of coal (bituminous) per hour on each foot of grate—the most perfect combustion ever seen on any boat that I know of; no black smoke ever seen.

"The Cunard steamer, *America*, has but 295 feet of grate, although the boilers occupy the same area (the height I do not know), and they are said to burn 800 tons per voyage; which is 23lbs. per hour on each foot of grate, provided it were done in 11 days.

There is no material difference in the engines of the above-named steamers, except that the *Atlantic* has balanced valves; if, therefore, she beats the Cunarder's, as she most *undoubtedly* will, the merit must be in her *boilers* (four), small but powerful; the method of alternate firing is the cause of the combustion being so perfect.

There are four boilers, and they are fixed fore and aft. The fire doors are double, and have water circulating between the two plates of the doors. A carriage travels from side to side of the vessel by a screw; this carriage is a large coalscuttle, which goes under the coal bunkers, and is then moved by the screw opposite to each fire hole: the upper fire-places are fed from a stage.

There is a bell in the engine house, and before it are five holes in a box; and by the side of the paddle-wheel are five pulls like bell-pulls. When one of these is pulled, it rings the bell in the engine house, and throws up a label opposite one of the five holes, and the one previously up is, by the same motion, thrown down, so that only one label is up at a time, and the one last pulled remains up. This does away with the hooting and shouting heard on board all our steamers.

The cabins are heated by hot-water apparatus, and the steamer is ventilated by upright wrought-iron tubes all round the vessel, the open ends being protected from down currents or from wet getting down them.

The fittings are magnificent, and the accommodations most commodious. The machinery of the *Atlantic* was constructed by Stillman, Allen, and Co., of the Novelty Works, New York. She is amply supplied with Francis's metallic life-boats. She has no wooden boats. They are made of galvanized iron. Four hang on the quarters. She carries one of great capacity on the house as a "deck" or "spare boat." She has also on board a "life car," so as to be able to communicate with the shore under any circumstances. The *Atlantic*, as well as the other vessels building for the same line, are so constructed as to be convertible into vessels of war in a few days should necessity require.

The following are the principal dimensions of the *Atlantic*:—Length between perpendiculars, 276 feet; breadth of beam, 45 feet; breadth across paddles, 75 feet; depth of hold, 31 feet 7 inches; diameter of wheel, 36 feet; length of stroke, 9 feet; diameter of cylinder, 96 inches; power, 1000 horse; burthen, 2860 tons; saloon, 67 feet long, by 20 feet wide; dining saloon, 60 feet long, by 42 feet wide.

The most obvious peculiarity is *the entire absence of bowsprit and jib-boom.*

On arriving at Liverpool, the *Atlantic* was found to be too large for any of the Docks there, so that she of necessity lay out in the river.

The *Pacific* is a sister vessel; and her cost is stated at about £115,000.

FORCE OF WAVES.

At the late meeting of the British Association,* Mr. Stevenson reported the result of certain observations made by him on the Force of the Waves, with reference to the Construction of Marine Works. Mr. Stevenson employed a self-registering instrument, consisting of a disc on which the sea impinges, and the impact is registered by means of a spiral spring. The result of the experiments hitherto made may be stated to be a force of about $1\frac{1}{2}$ tons per square foot for the German Ocean, and of 3 tons for the Atlantic Ocean. The experiments were made at Bell Rock and Skerryvore lighthouses.

MEASURING AND REGISTERING THE FLOW OF LIQUIDS.

Mr. Parkinson, of Bury, has patented a Liquid Meter, consisting of a tub-shaped vessel in halves, united at the centre by flanges, to which are attached the edges of an elastic bag. Upon the top of the vessel is a valve-box, into which water flows from the main, and which communicates with the top and with the bottom (by a vertical tube) alternately. Two curved plates are riveted together on either side of the elastic bag, and constitute a species of piston. A slide is placed in the valve-box, which, as it is moved to and fro, establishes a communication between the main and the spaces above and beneath the piston, and also between them and the outflow pipe alternately. The valve is worked by a toothed segment, which is keyed on a spindle; and this, passing through a stuffing-box in the valve-box, carries outside a plate with two teeth, into the space between which a projection works on a tumbler lever. The piston is connected by a chain to a rod, which slides in a stuffing-box in the top of the vessel, and carries at top a toothed rack; into this gears a pinion keyed upon a spindle which carries another pinion that gears into a horizontal rack; and this is fitted with a lever having a click, which at every movement of the horizontal rack causes a ratchet wheel to make one-tenth of a revolution. This movement is communicated to a registering apparatus in the usual way. The horizontal rack is made to impart motion to the tumbler lever. Supposing the water to flow from the main, through the valve-box, into the top of the vessel above the piston, which will thereby be gradually forced to the bottom of it,—then the water which was beneath the piston will be forced out up the vertical pipe through the outflow; and when the piston has arrived at the bottom it will draw the rod down, and by means of the connecting parts will raise the tumbler lever beyond the perpendicular, when it will fall on the other side, and through the toothed segment, whilst gearing will reverse the position of the valve, upon which the water will descend through the vertical pipe into the bottom of the vessel, and force what water was above the piston through the outflow pipe. As the piston ascends it will gradually push the rod up, and thereby reverse the position of the valve. In a modification of this meter, the elastic bag is replaced by a non-elastic piston.—*Patentee's Description.*

* Held at Edinburgh, July 31; August 7.

HYDRAULIC PRESSES.

In most cases, Hydraulic Presses fail by splitting vertically down the centre; and, on account of the incompressibility of water, the fracture is generally quiet and gradual. In consequence of the frequency of such failures, it has been supposed by some experienced makers, that, after being for a certain time exposed to so great a strain as three tons per circular inch, all cylinders will ultimately fail. There appear, however, after careful inquiry, no good grounds for this conclusion: the imperfection of the safety valve renders it at all times doubtful what pressure is actually employed; and most cases of failure may be traced to some unusual pressure. An 18-inch press has been in constant use for many years by Mr. Amos, the pressure being always three tons, and on some occasions four tons per circular inch. In some extensive works at Dover, where large hydraulic presses are used for drawing oil, five double and two single presses have been long in use; the pressure is constantly upwards of three tons; three cylinders have failed, and were all found to be defective castings; and one double press has been up 102,000 times.

Wrought iron would doubtless give perfect security; but the construction of such large cylinders (as used at the Britannia Bridge) would be next to impracticable. Brass presses are sometimes used, and the ram is sometimes successfully lined with brass to lessen the wear.

The area of the large press for the Britannia Bridge was 314.16 square inches, and the capacity with a 6-feet stroke 2216.5 cubic inches. The quantity of water employed for a 6-feet lift is therefore 81.57 gallons = 815.7 lbs.

The pressure at three tons per circular inch = 3.819 tons per square inch, which would raise a column of water 5.41 miles in height; this pressure would, therefore, be sufficient to throw water over the highest mountains on the globe. The ratio of the area of the pump to that of the cylinder is as 1 : 354.3.

It is evident that, instead of a force pump, a head of water may be conveniently employed for forcing water into the cylinder; and in this manner power may be stored up ready for use. The hydraulic press in this form is used for working cranes, for unloading vessels, and other purposes where a more rapid motion is requisite.

In all cases where great pressure is required, the steady character of its action adds greatly to its utility; among other uses, it is extensively employed for compressing wool and hay; to facilitate packing, for drawing oil from seeds, for drawing lead and pewter pipes, for glazing paper (commonly called hot-pressing), for raising vessels in dry docks, for raising turn-tables and swing bridges on a vertical pivot to facilitate their circular motion, for pressing metals into moulds; and, in a portable form, a small press forms a very convenient substitute for the screw-jack, and has been extensively employed in moving heavy weights during the construction of the Britannia and Conway Bridges.—*Clark, on the Britannia and Conway Tubular Bridges.*

WRIGHT'S PATENT STEAM GENERATOR.

The principle of this invention consists in applying to the Boilers of Steam-engines an arrangement of what are called "cellular vessels," formed of malleable cast iron; one vessel being placed underneath the boiler and over the fire, while the other is placed within the boiler. They are connected by means of bent tubes, so as to have free communication with each other, but are insulated as regards the water in the boiler. They are charged with water, which, except from any slight unavoidable waste, is never changed; and there is a small safety-valve connected with them, which is so loaded that the temperature of the insulated water contained in the cellular vessels, may, if necessary, be raised to 400° or 500° of Fahrenheit, without forming into steam. The vessels, therefore, remain perfectly charged, and the insulated water in the lower vessel taking up the principal portion of the heat of the fire, rises by its inferior gravity through the bent tubes, and is diffused through all parts of the cellular vessel within the boiler. The excess of heat is then instantly given off to the water in the boiler, and the insulated water descends by increased gravity to take up a fresh charge of heat. The result of the experiments made with this ingenious invention has been an evaporation at the rate of 12 8-10ths of water to 1 lb. of coal, the rate given by the present construction of boilers being stated at 8 lbs. of water to 1 lb. of coal. Besides the saving of fuel which would thus appear to be effected, there is also the obvious advantage that the flame hardly impinges upon the boiler from the intervention of the cellular vessel, and the boiler is thus saved from the rapid deterioration to which it is now exposed by the excessive heat which plays upon it. The principle of the invention is equally applicable to every boiling and evaporating process; but if, after a more extensive practical experience, it is found to answer, the economy which it secures will probably be most advantageously felt in the case of marine engines, the space required for the stowage of fuel in steam-vessels being at present so very large.—*Times*.

CAPTAIN FITZMAURICE'S ROTARY ENGINE.

Several private trials have taken place at Taplow-on-the-Thames with a Rotary Engine, which has been brought to its present working condition by Captain the Hon. W. E. Fitzmaurice (late 2d Life Guards) and his brother-in-law, Mr. Harford. The engine is very simple, merely consisting of two pieces so mathematically arranged that the interior part works in the outer with the greatest ease, being free from dead points, and without the slightest vibration, however great the velocity. It has no springs or packing, and the parts meet each other so harmoniously as only to give a humming noise like a spinning top; and it is not in the least liable to get out of order, the wear being perfectly uniform throughout. The entire motion being a rolling instead of a cutting one, the engine will last long without repair, as the surfaces become case-hardened in a very

short space of time. The trials took place in the presence of several scientific gentlemen and engineers of eminence in their professions in a frigate's pinnace, the engine being constructed for the government. The boat is of 10 tons burden, carrying a load of $5\frac{1}{2}$ tons, and drawing 4 feet of water. She is 32 feet long and 8 feet breadth of beam, made for carrying men and carronades, but not in any way calculated for speed, and yet the engine of 10-horse power, occupying a space 21 by 7 inches, drove a screw-propeller of 3 feet in diameter and 4 feet pitch with such velocity as to make 200 revolutions in a minute, the motion being given on the direct-action principle. Although the boat was not at all calculated for speed, she was propelled against the stream a distance of two miles in 20 minutes, equal, allowing for the strength of the current, to 8 miles an hour. The engine weighs considerably less than 1 cwt. to each horse-power, and requires much less fuel than the ordinary engines, and is so easily set in motion, graduated to any velocity, or stopped, that a boy of twelve years of age might manage it with one hand. It was made under the superintendence of M. Bulman, jun. of Croydon. Capt. Fitzmaurice made no secret of the invention, but showed its interior freely, as it was intended for the public service. An engine of 100-horse power on Capt. Fitzmaurice's construction would only occupy a space of 6 feet by 2 feet.—*Times.*

SIEMAN'S REGENERATIVE CONDENSER.

THIS Condenser was suggested to Mr. Sieman by Mr. Graham, of Mayfield Works, in order "to recover the heat from the condensing water in the form of a reduced amount of boiling hot water." It consists of an upright rectangular trunk of cast-iron, the lower end of which is cylindrical, and contains a working piston, which performs two strokes for each one of the engine. In the trunk is a set of copper plates, upright and parallel to each other,—the intervening spaces being the same as the thickness of the plates, viz., between $\frac{1}{12}$th and $\frac{1}{16}$th of an inch. The upper extremity of the condenser communicates on one side with the exhausté port of the engine, and on the other through a valve with the hot-well. The plates are fastened together by five or more thin bolts, with small distance-washers between each plate. There is a lid at the top of the trunk, by removing which the set of plates can be lifted out. Immediately below the plates the injection-pipe enters. The action of the condenser is as follows:—Motion is given to the piston. At the moment that the exhaust-port of the engine opens, the plates are completely immersed in water, a little of which has entered the passage above the plates, and is, together with the air present, carried off by the rush of steam into the hot well, the excess of steam escaping into the atmosphere. The water then, in consequence of the downward motion of the piston, recedes between the plates, exposing them gradually to the steam, which condenses on them. Their upper edges emerging first from the receding water are surrounded by steam of atmospheric pressure, and become rapidly

heated to about 210 degrees. The emersion of the plates still continuing, the steam is constantly brought into contact with fresh cool surface, by which the greater portion of it is condensed, until, as the piston descends, the injection enters and completes the vacuum. This is done by the time the working piston of the engine has accomplished $\frac{1}{7}$th of its stroke. The upper extremities of the plates become heated to near 210 degress, and the lower to about 160 degrees. Taking the initial temperature of the condensing water at 69 degrees, the final temperature at 210 degrees, the latent heat of steam at 212 degrees, 960 units, the quantity of water required, is 6·61b. to condense 1lb. of steam of atmospheric pressure. The common injection condenser, (supposing the temperature of the condensed steam to be 110 degrees,) requires 21·21b. in place of 6·61b.—*Builder*, No. 381.

ON THE INCRUSTATIONS WHICH FORM IN THE BOILERS OF STEAM ENGINES. BY DR. JOHN DAVY.

On entering on this inquiry, which I did after my return from the West Indies in December, 1848, and after communicating a short paper to the Royal Society "On Carbonate of Lime in Sea-water," it appeared to me desirable to collect as many specimens as possible of Incrustation from the Boilers of Steam vessels, now so widely employed in home and distant navigation. The character and composition of the incrustation, whether formed from deposition from water of narrow seas or of the ocean, I have found very similar—with few exceptions, crystalline in structure, and, without any exception, composed chiefly of sulphate of lime; so much so, indeed, that, unless chemically viewed, the other ingredients may be held to be of little moment, rarely amounting to five per cent of the whole.

To endeavour to prevent the deposition of the incrusting matter or to mitigate the evil, various methods, it would appear, have been had recourse to—some of a chemical kind, as the addition of muriate of ammonia and sulphate of ammonia to the water in the boiler—without success, as might be expected;—others, of a mechanical kind, with partial success—as the introduction of a certain quantity of sawdust into the boiler, or the application of tallow, or of a mixture of tallow and plumbago to its inside, to prevent close adhesion, and the more easy separation of the incrusting matter either by percussion, using a chisel-like hammer—or by contraction and unequal expansion, by means of flame kindled with oakum, after emptying the boiler and drying it. Of all the methods hitherto used, that of "blowing off,"—that is, the discharging by an inferior stop-cock a certain quantity of the concentrated water of the boiler by the pressure of steam, after the admission above of an equivalent quantity of sea water of ordinary density, appears to be, from the reports made, the most easy in practice, the least unsuccessful, and the most to be relied on. But it can be viewed only as a palliation. Considering the composition of the incrusting matter and the properties of its principal ingredient, the sulphate of lime, a compound soluble in water and in sea water, and

deposited only when the water containing it is concentrated to a certain degree, there appears to be no difficulty theoretically in naming a preventive. The certain preventive would be the substitution of distilled or rain water in the boiler for sea water. Of this we have proof in the efficacy of Hall's condenser, which returns the water used as steam, condensed, after having been so used: but, unfortunately for its practical success, the apparatus is described as being too complicated and expensive for common adoption. Further proof is afforded in the fact that the boilers of steamers navigating lakes and rivers in the waters of which there is little or no sulphate of lime, month after month in continued use, remain free from incrustation. This I am assured is the case with the steamers that have been plying several summers successively on the lake of Windermere. And it may be inferred, that in sea-going steamers in which sea water is used in the boiler—or, indeed, any water containing sulphate of lime, the prevention of deposition may be effected with no less certainty by keeping the water at that degree of dilution at which the sulphate of lime is not separated from the water in which it is dissolved. From the few trials I have made, I may remark that sulphate of lime appears to be hardly less soluble, if at all less, in water saturated with common salt than in perfectly fresh water. This seems to be a fortunate circumstance in relation to the inquiry as to the means of prevention, and likely to simplify the problem. If these principles be sound, their application under different circumstances, with knowledge and judgment on the part of the directing engineer, will probably not be difficult. His great object will be in sea-going steamers to economise the escape of water in the form of steam, and thereby also economise heat and fuel; also, when fresh water is available, to use it as much as possible; and further, to avoid using sea water as much as possible near coasts and in parts of seas where sulphate of lime is most abundant. From the incrustation on the boilers of sea-going steamers, the attention can hardly fail to be directed to that which often forms, to their no small detriment, in the boilers of locomotive-railway engines, and of engines employed in mines, and in the multifarious works to which steam power is now applied.

These incrustations will of necessity be very variable, both in quantity and quality, according to the kind of ingredients held in solution in the water used for generating the steam. Hitherto I have examined two specimens only of incrustations taken from the boilers of locomotive engines, and a single one only from the boiler of a steam engine employed on a mine—a mine in the west of Cornwall. The latter was fibrous, about half an inch thick, and consisted chiefly of sulphate of lime, with a little silica and peroxide of iron, and a trace of fluorine. The former were from one-tenth of an inch in thickness to one inch. They were laminated, of a gray colour, and had much the appearance of volcanic tufa; they consisted principally of cerbonate and sulphate of lime with a little magnesia, protoxide of iron, silica, and carbonaceous matter; the last two,

the silica and carbonaceous matter, probably chiefly derived from the smoke of the engine and the dust in the air. From the engineer's report it would appear that the thinnest—the incrustation of about one-tenth of an inch—had formed in about a week, during which time the locomotive had run about 436 miles, and consumed about 10,900 gallons of water.—*From a Letter addressed to Dr. E. Wilson, F.R.S.E.: Proceedings of the British Association.*

MARINE PROPULSION.

A QUESTION of considerable interest, in respect to Steam Navigation, has been argued before the Judicial Committee, at the Privy Council-office, Whitehall, Lords Brougham, Campbell, and Langdale, Dr. Lushington, and Mr. Pemberton Leigh, being present. An application was made by Sir Frederick Thesiger, on behalf of the patentees of the screw propeller, for an extension of their patent, which would expire shortly. The evidence went to prove that no less than 30,000*l.* had been expended in building the *Archimedes*, and in defraying other weighty charges to establish the Screw-propulsion principle; and it further appeared, that although no less than 32 ships-of-war and 100 mercantile steam-vessels had been constructed already upon this system, not more than two or three had paid for the patent license. These evasions had been occasioned by the conflicting claims of five different patentees; but, as these have now united in one Association, it is expected that all who have adopted the use of the screw-propeller will have to pay for their licenses. As the Admiralty are interested, either directly or collaterally, in this question to the amount of about 25,000*l.*, Sir John Jervis, the Attorney-General, assisted by Mr. Crowder, Q.C., opposed the application for an extension of Mr. Frank Pettit Smith's patent; but, after examining Captains Chappell and Crispen, R.N., and Messrs. Brunel and Galloway, engineers, their Lordships decided on granting an extension of five years to Mr. Smith's patent upon certain conditions.—*Times.*

STEAM FOR THE ANDES.

AN iron Steam-boat of small size has been built by Mr. George Birkbeck, Jun., of New York. This boat is 55 feet keel, 12 feet beam, and 5 feet hold. She is to be propelled by two high-pressure engines, of ten horses power each, connected at right angles. Water wheels ten feet diameter, and of wrought iron. The whole being fitted together in New York, and each piece marked before being shipped. No piece is to exceed in weight 350lbs., as, on its arrival in Lima, it has to be transported on the backs of mules to its destination, Lake Titicaca, which is situated near the summit of some of the highest mountains in that country, and several miles above the level of the sea. As yet, commerce must be in its infancy in that elevated region; but the lake is 140 miles long, and its coast well timbered, and it is understood that much traffic would be the result of increased facilities. In case the first boat succeeds, a larger one is to be sent out immediately.—*Journal of the Franklin Institute.*

SALINOMETER.

Mr. Andrew Peddie How, of the United States, engineer, has patented this instrument, by the use of which, and the mere inspection of the indications which it affords, the exact degree of density, and consequently of saltness, possessed by the water in the boilers of marine steam engines, can be ascertained at all times and under all circumstances, independently of the pressure in the boiler; and the engineer be thereby enabled to determine when the water has attained to such a degree of saturation as to render freshening necessary, in order to prevent the deposition of salt taking place. This instrument consists of a vertical cylinder communicating at bottom with the lower and upper strata of the water in the boiler, by means of two passages, and containing a floating hydrometer, which carries a graduated stalk. The cylinder is provided with an overflow and waste pipe, and a thermometer.

When the boilers are at work, one only of the passages is kept open at a time. The consequence is, that the cylinder is first filled to the height of the mouth of the overflow pipe, and that then a continuous inflow takes place on the one hand from the boiler, and a continuous outflow through the waste pipe on the other; that is to say, there is a constant flow of water through the Salinometer, of the same density precisely as the water in that part of the boiler from which the supply is derived; and which density is shown on the graduated stalk of the hydrometer. A thermometer is combined with the instrument, because the density or saltness of the water varies with the degree of temperature, and it is necessary to correct the indications of the hydrometer by those of the thermometer, as often as the hydrometer rises or falls beyond the standard point to which it may have been graduated.

REEFING TOPSAILS FROM THE DECK.

This ingenious contrivance has been fitted on board one of the Peninsular and Oriental Company's vessels, the *Iberia*, and found to answer admirably. The sail reefs itself, and from the time the yard is lowered it is close-reefed in two seconds. The reefs may be again shaken out, and the top-sail at the masthead in twenty seconds. In nautical affairs this contrivance is one of the wonders of the age, and must be rapidly brought into general use. The invention, patented by Mr. H. D. P. Cunningham, R.N., late secretary to Admiral Moresby, is not expensive, because the present sails and topsail yards can easily be altered at an expense not exceeding 15*l*. per yard and sail. It is well known to officers that many a reef is kept in during the night, and in consequence the vessel's progress is retarded, on account of a disinclination to send men aloft, more particularly if the weather be wet. With this admirable contrivance, sail can be taken in, and again made, in a short space of time, without sending a man aloft. The invention is of more importance to the commercial marine than to the Royal Navy; but, of course, it is equally applicable to both, and must manifestly save much anxiety,

and do away with the risk of losing men off the yards when reefers in bad weather, more particularly in frosty weather, off Cape Horn, &c. We trust Mr. Cunningham will be more successful with this than with his other admirable inventions; we particularly allude to his plan for checking the recoil of heavy guns by means of compressing the air in a small cylinder fitted under the breach of the gun.—*Portsmouth Times.*

BONNEY'S SAFETY YACHT.

A YACHT of very peculiar construction has been exhibited on the Serpentine, opposite the Royal Humane Society's Receiving-house. It is the invention of Mr. W. W. Bonney, of Claremont Villa, St. John's, Fulham, who has registered the design. The dimensions, &c., of the vessel are as follows:—

Length, 15 ft. 6 ins.; breadth, 4 ft. 10 ins.; depth, 2 ft. 4 ins. Hull, clinker-built; planks of gutta percha (but the principle of formation will permit of the employment of other materials), cemented and copper-riveted together; the sides are doubled from the bilge upward to the spar deck, and are divided into water-tight compartments: the fore and aft parts of the boat are also divided into water-tight compartments, as in the outer gunwale. The keel and keelson are of iron; the latter is grooved to receive the ribs, and all are bolted together. The deck is double-laid, the upper diagonally with marine glue. The bilge timbers are deeper than usual, acting as extra keels; they, with the buoyancy of the outerwale, and the iron keel and keelson acting as counterpoise, render it next to impossible to capsize her.

All the anticipations formed, not only of her floating, but of her sailing capabilities, were fully realized. She was repeatedly filled with water; men in attendance got into her, and there being a very stiff breeze blowing, her powers of resisting overturning were fully tested, and with complete success; for not only was she not water-logged, but her rate of progression when filled was scarcely impeded, as compared with what would have been the case with a boat of ordinary construction; though, indeed, any such boat, under the circumstances, would have necessarily been wholly unmanageable and useless. From these experiments, it may safely be assumed that boats built on Mr. Bonney's plan cannot be sunk or capsized by accident, and scarcely intentionally; and this plan, it will be observed, is applicable to craft of all sizes, and of any external lines, so that boats already in use can have the principle of the safety yacht applied to them at a moderate expense. It would be difficult to exaggerate the importance of the extension of this discovery to life, fishing, and race boats; and we look for a speedy and extensive recognition of its merits at the hands of the Royal Yacht and other marine clubs.

The following additional experiments have been made by the desire of some noblemen and gentlemen particularly interested in nautical

matters, in order to test still further the remarkable capabilities of this yacht :—

1. The yacht was hauled over, and so half filled with water; on being released, she righted immediately. She was then quite filled, and in that state she sailed and answered her helm well.

2. Two men sat upon the extreme end of her counter.

3. They then went forward; one (fifteen stone weight) stood upon her bowsprit, the other upon her stern.

4. They stood upon and overhung her gunwale.

5. They hung on from the mast-head, and hauled the mast-head, with sails set, under water; immediately on their releasing hold the boat righted.

6. She was lastly pressed down by the mast-head, with her sails set, till she was bottom upwards, and when the pressure was removed she righted.

A CLOAK BOAT.

A Cloak Boat, manufactured of India-rubber, from the design of Lieut. R. A. Halkett, R.N., by Mr. Matthews, of Charing-cross, has been thus experimented with. A blue cloak, of the Macintosh make, was laid on the floor of a shed, the outside being next the door, and a wicker sort of mat was deposited on it, which formed a flat bottom, the cloak having an air-proof cylinder; and within one minute it was thoroughly inflated, and thus suddenly metamorphosed into a boat, glided into the water, a gentleman being seated in it, and rowing at different intervals with a couple of hand-paddles, being shaped like the looking-glasses. This boat is extremely serviceable to persons travelling, for the purpose of crossing rivers or streams where no other means are at hand. It is instantly available, and can, in cases of necessity, be converted into an excellent bed. The weight of this kind of boat, with bellows and paddles, is about 9 lbs. An umbrella, to act as a sail, can also be furnished, if required.

HOLBROOK'S NEW LIFE-BOAT.

Mr. J. N. Holbrook, of Hull, has constructed a Model Life-Boat, the hull of which is broad, and appears admirably adapted to resist the severest concussions of the waves. The framework of this hull is entirely composed of wrought iron, covered with net. The body of the vessel consists of six compartments, containing barrels or "floaters" perfectly air-tight, and so separated from each other that in the event of one or more of them being punctured, the buoyancy of the boat would be still preserved. The floaters are warranted not to break, burst, or rust. The peculiarity of the vessel consists in this, that—strange as it may sound to some of our readers—it has no "bottom," except a slight framework of cordage or netting; the object of this arrangement being to allow the water to rise within the boat to the level of that without, and so to secure a permanent ballast of water, which will preclude the possibility of the vessel

being capsized in a heavy sea—the great problem hitherto unsolved by the inventors of life-preservers. By the plan thus briefly and imperfectly described, the countervailing properties of buoyancy and steadiness are perfectly secured. The only objection that would oppose itself to the efficacy of Mr. Holbrook's life-boat is, the difficulty of manœuvring a vessel of such breadth of beam; but we understand that it is intended to be kept on board ship, and so constructed that it may be stowed away with great facility. Another objection, that the admission of the water would not be exactly conducive to the comfort of those inside the boat, would hardly be insisted on by the most fastidious with the alternative of an ocean grave before them. The internal arrangements are complete. They include contrivances for carrying fresh water, spirits, matches, wood, articles of wearing apparel, &c., with an apparatus for boiling coffee and broiling meat. The boat also carries a reflecting lamp, fire balls, blue lights, a rocket with 300 feet of line, a horn, and an alarm bell. It is steered by means of an oar. Additional or extra "floaters," used as bulwarks in smooth water, inclose masts, sails, and oars, which can be taken out and made use of at sea if occasion require. It has already been approved by the Lords of the Admiralty, the Masters of the Trinity House, and several eminent scientific authorities,—and been tested on the Humber, off Southend, and elsewhere.

SAFETY STEERING WHEEL.

Capt. Fayrer, R.N. has exhibited to the Society of Arts, a model of his Safety Steering-wheel, for preventing the accidents that occur to steersmen of large vessels owing to their want of command over the wheel. The additional command is gained by the use of a friction band similar to those used in cranes passing round the wheel, and connected with a pedal by which any amount of retarding pressure may be exerted by the helmsman. The invention is calculated to be also very efficient in preventing the wear and tear arising from the constant motion of the rudders of ships lying in tideways or harbours.

PROVISION AGAINST SHIPWRECKS.

Mr. George Catlin has devised a plan for saving the lives of all persons on board a perishing ship. "My design," he says, "was to construct disengaging and floating quarter-decks to ocean steamers and other vessels, answering all the purposes of ordinary decks, and which, in case of vessels sinking at sea, could in a few moments be disengaged, and prepared with all the passengers and crew upon them, to float away, as strong and efficient rafts, when vessels go down. These I considered equally available in case of vessels burning at sea: the vessel scuttled might be sent down, and all on board (at least with a ray of hope) might launch themselves upon the middle of the ocean. These quarter-decks or rafts I propose to be built chiefly of solid timbers which could not sink—they could not

be capsized by a wave, nor would they stave or founder like a boat upon a reef, but would float in safety over it, and land their passengers on the beach. Tin or sheet-iron safes, water tight, might be sunk into them, containing provisions, liquors, &c., for twenty or thirty days days at sea, and also rockets and other means of making signals of distress." We learn that a similar invention had previously been patented by Capt. Oldmixon.

SELF-REGISTERING TIDAL GAUGE, SUNDERLAND

At the mouth of Sunderland Harbour, Mr. Meik, C.E., of that port, and Mr. H. Watson, brass-founder, of Newcastle-upon-Tyne, have constructed a new Gauge, as follows:—A well, carefully boxed in, and of similar depth to the water on the bar, is made below the building which contains the apparatus. Within this well, in an interior pipe or trunk, and rising and falling with the tide, works a float suspended by copper wire cord, which is carried over a spiral cone fixed in an upper story of the building. By the simple arrangement of a wheel and pinion at the opposite end of the axle to which the cone is fixed, a web of wire gauze works on two rollers fixed at the upper and lower ends of the web. The lower roller is regulated by the movement of this wheel and pinion; the upper one by a balance-weight attached to a copper wire-cord, which also passes over another spiral cone, having at the extremity of its axle a second wheel and pinion similar to the first. As the float rises and falls with the tide, the wheels and pinions connected with the cones, over which the cords of the float and balance-weight respectively pass, move the rollers on which the gauze web travels. On this web are painted in large figures the various depths from high to low water, and as the web works, two fixed pointers indicate the number of feet and half feet on the bar at any hour of the tide.

The web and the figures on it can be made of any size, and to travel 4, 6, 8, 10, or any other proportion, to 1 of the float, by regulating the size of the wheels and pinions. By day the figures on the web are shown white on a black ground; by night they appear distinctly lighted up, the ground still remaining dark. A white transparent varnish is used for the figures, and an opaque black for the ground. The illumination by night is so steady and powerful, that the figures, if made large enough, and the apparatus placed at a sufficient elevation, will be visible at a considerable distance at sea, and thus afford vessels the means of knowing the exact depth of water at the mouth of any harbour before entering it. This simple piece of mechanism is applicable to all places where the want of a correct and conspicuous gauge has been felt, not only in harbours and docks, but at railway stations, for signals and such like purposes. The apparatus used occupies so little space, that it can all be contained and worked in a column or pillar, without any other building.—*The Expositor*, No. 5.

FLOATING CAISSON GATE AT PLYMOUTH DOCKYARD.

This work has been completed for the new works at Keyham (connected with the Plymouth Yard), by Messrs. William Fairbairn and Sons, of Manchester.

The Caisson is a huge hollow iron box of the form of the entrance to the lock, perfectly flat at the sides, 82 feet 6 inches long at the top, only 13 feet 6 inches wide, and of the enormous depth or height of 42 feet. The lower part of this box is formed into an air chamber, or what may be termed the lungs of the caisson, by a strong iron deck, which is carried from side to side at a height of about 12 feet from the bottom, and made perfectly air-tight. The capacity of this air chamber is so adjusted that when the caisson is immersed in water, the confined air exerts a buoyancy a little in excess of the total weight of the caisson; and as by means of sluice valves the water is allowed to enter the inside of the caisson and fill it from the top deck of the air chamber upwards to the level of the water outside, whatever that may be, it follows that at any point of the tide, and with any depth of water greater than that which would float it, the caisson would swim a few inches clear of the masonry. The total depth of the caisson is about 5 feet greater than the depth of the water at the entrance to the lock at high spring-tide, and this space is made available for the means employed for sinking and moving the caisson. A water-tight tank is formed in this part of the caisson capable of holding 60 to 70 tons of water supplied to it from the water-main of the dockyard; and it depends upon the presence or absence of this quantity of water in the upper tank whether the caisson remains firmly resting on the masonry and closing completely the entrance to the lock, or floats a few inches clear of the floor ready to be hauled by capstans into the recess in the earthwork which has been prepared.

The ingenious manner in which the buoyant principle is taken advantage of (says the Editor of the *Mechanics' Magazine*) constitutes the most meritorious feature of this scheme, for the emission of the small quantity of water confined in the top tank (which, by means of an ordinary valve placed in its bottom, is accomplished in about two minutes) dispenses with the laborious and expensive process of pumping, which has usually to be resorted to.

METROPOLITAN TUNNELLING AND RIVER EMBANKMENT.

Mr. W. H. Smith has published a Sewerage and Water Supply Plan, comprising a terraced embankment of the Thames (*à la* Martin), beneath which should be lines of tunnelled railway communicating with the various metropolitan termini of the great trunk railway lines,—water culverts and pipes,—and large sewer courses. Immediately under the roadway of the embankment, and above the tunnels, Mr. Smith proposes that there should be transverse arches communicating with the Thames, for commerce and traffic on the river. The esplanade would be 60 feet wide, protected by a parapet next the river, and on the other side lined with handsome houses,

disposed according to the sweep of the river. With respect to the railway tunnels, descent and ascent would be by inclined plane. The supply of pure water would be taken from a place high up in the Thames above the point of tidal action, andraised by high-pressure to supply the most elevated districts. The termini of the sewer tunnels would be some twenty miles below Blackwall, in the Thames marshes, below the floating power of the tide to carry it back to the metropolis. The embankment should extend from Vauxhall to the West India Docks and Deptford—that is, about ten miles—and the estimate of the cost of construction be fixed at £300,000 per mile, or £3,000,000 altogether.

PROPOSED BRIDGE OVER THE RHINE AT COLOGNE.

In the spring of 1850, the Prussian Government publicly stated their desire to obtain designs from engineers and architects of every nation for the construction of a Bridge over the Rhine, at Cologne, to carry a railway as well as the ordinary road and footways, from Cologne to Deutz, on the eastern bank of the river. The designs were restricted by certain conditions, of which the expense of the proposed construction was a prominent feature.

In August last, 62 designs were sent in to the Board of Public Works in Berlin, many of them being from England. The Royal Commission appointed to examine these designs rejected 41 in the first instance, as more or less inapplicable to the required conditions; and on further examination seven more were set aside from the same cause. The remaining 14 were then subjected to additional scrutiny, and three were selected for final preference. Of the three thus selected, two, as we have already mentioned, were eventually adjudged deserving of the prizes, being the design presented by Mr. J. W. Schwedler, architect, of Berlin, and the design by Capt. W. Moorsoon, civil engineer, of London. Of the latter of these we now give the following particulars:—

	Feet.
The length of the bridge across the water is	1,275
" of the approaches and land arches	740
Total length of the bridge and approaches	2,015
Span in the clear of each of the two main arches	600
" ditto of lifting arch	100
Breadth of roadway for carriages over the bridge	25
" of railway for double track over do.	25
" of two footways on the upper floor	13
Width of piers in the river, two, each of	35
Height from the bed of the river to the underside of the lowest part of each arch	50
" from the bed of the river to the underside of the lifting arch when raised	104
" from the foundations to the top of the towers	147
	Tons.
Strength of each main arch to resist a load distributed over it	5,750
Cost of the whole of the works excepting the basement and foundations of the towers in the river	£211,240

Cost of the basement and foundations in the river, which the Government propose to execute themselves	25,540
Total cost if executed at Prussian prices	£236,780

If executed in England, the cost would be one-fifth less.

The scale of the drawing is 300 feet to one inch.

The girders are simple repetitions of iron bars (rolled); and Capt. M.'s proposal to the Prussian government (which is still under consideration) is, to build one centre tower and one shore tower first, and place temporary scaffolding in the river between these, leaving the other part of the river open. The stages supported on this scaffolding are said to be ample for constructing the girder, which is previously fitted (but not rivetted) on the shore, and each piece marked. Captain M. has found that 75*l.* is the cost of scaffolding for a girder of this kind, 160 feet long and 40 feet high, above *dry* ground; and 300*l.* is the cost of ditto for a girder, 220 feet long and 80 feet high, above a river 9 feet deep.—*Builder*, No. 404.

LEWISTON AND QUEENSTON SUSPENSION BRIDGE.

This Bridge, which when completed will be by many feet the longest in the world in one clear span, has been put under contract by the joint Companies holding the charters from the New York and British Governments. Capt. E. W. Serrell has been appointed the engineer to carry the project out to completion. The bridge will connect the shores of the Niagara River at Lewiston, New York, Queenston, Canada West, and will be 1042 feet between the points of support; the roadway will be 75 feet above the water, 19 feet wide, and will be capable of sustaining a load of 800 tons. The towers of support are to be built of hydraulic masonry, surmounted with cast-iron caps, which are 76 feet above the roadway. The natural advantages of the locality are so great, that it is estimated to cost much less than so large a work would in almost any other place.—*Architect*.

GREAT SUSPENSION BRIDGE IN RUSSIA.

Considerable interest has been excited in St. Petersburgh by a remarkable Model of a Suspension Bridge across the river Dnieper, at Kieff, one of the principal cities of Russia. This model was made in London, where it was exhibited to most of the principal engineers and architects. It has since arrived in St. Petersburgh, and has been put up in one of the grand saloons of the Winter Palace, where it was formally presented to His Imperial Majesty on his *fête* day, the 6th (18th) of December, 1849, by Mr. Vignoles, the English engineer, from whose designs, and under whose immediate directions, the bridge is now constructing.

The soil of the bed of the river being wholly of sand, and the current often changing its channel, considerable difficulties presented themselves, while the tremendous breaking up of the ice after winter,

followed by the melting of the snows in the more northern districts, swelled the stream to an extent scarcely comprehensible to the inhabitants of Great Britain. It became, therefore, a necessary condition that the number of piers of any bridge to be built there should be the fewest possible, with the largest openings between them. Hence it seemed most natural that, with the given limit of expense, the principle of a suspension bridge should be preferred, and the designs were so prepared accordingly, and submitted to His Imperial Majesty. On Mr. Vignoles's urgent recommendations, the use of wire ropes as the means of suspension was negatived, and the adoption of wrought iron chains with broad flat links was decided on. Such was the system employed for the Menai and Conway Bridges in Wales, by Telford, at several places in England, and also in Hungary, at Pesth, across the Danube, by Tierney Clarke. All these bridges, however, have but one central opening. The suspension bridge at Kieff has four principal openings, each of 440 feet, and two side openings of 225 feet each, and also a passage of 50 feet on the right shore, spanned by a swivel bridge, opening for the passage of the steam-boats and other river craft. There are, therefore, five suspension piers in the river, one mooring abutment on the left bank, another mooring abutment on the Kieff side of the stream (which, on account of the passage for boats beyond it, is actually an island of masonry in the river), and an abutment for the swivel bridge on the right bank. Each of these has required a coffer-dam of unusal size—particularly the two last mentioned.

The architecture of the river piers is rather novel, aud of a striking character, harmonizing with that used in the extensive range of first-class fortresses which crown the heights of Kieff. The ways through the piers have a clear breadth of 28 feet, and a height of 35 feet to the soffit of the semicircular arches. The platform has nearly 53 feet of extreme breadth, of which 35 feet are exclusively devoted to the carriage way; the platform is suspended by chains, all on the same horizontal plane, two on each side of the road; the footpaths project beyond the chains, and are carried by cantilevers round the piers exteriorly, so that the foot passengers are completely separated from the horsemen and carriages. The chains are composed of links 12 feet long, and each weighing about 4 cwt.—eight links form the breadth of each chain, and the total length measured along their curves being about four English miles. For the swivel bridge the iron employed is almost exclusively malleable; the breadth of the platform is nearly 56 feet, and the weight of iron employed scarcely exceeds 100 tons. The bridge is moved horizontally (on the same principle that locomotive engines are sent round on the large turn-tables at a railway station), and by the efforts of four men only, acting on a very simple apparatus.

The construction of the platform of the bridge presents several novel combinations of wood and iron, and is of extreme stiffness, to resist the violent action of the eddies of air in violent winds, which have so often injured, and even destroyed, the ordinary platforms of

suspension bridges in other places. The balustrade is remarkably light and elegant, in ornamental panels of wrought iron. Indeed, cast iron has been carefully excluded from every part of the whole bridge, except where its use was really preferable or absolutely unavoidable. The total weight of iron used in the construction of the bridge is about 3,300 tons, including the machinery used in the various stages of its construction. The whole was made in England, several of the most celebrated iron-masters and manufacturers having been engaged upon it. It required fifteen vessels to bring the iron to Odessa, whence it was taken up to Kieff in small waggons drawn by oxen, over the wild steppes, almost without roads, or none that deserve the name.

The quantity of machinery of every kind employed in the construction of the Kieff bridge is most enormous, and not less than nine steam engines are in use. Two of these are large stationary ones, each capable of working up to a power of 50 horses; the rest are from four to eight horses power, and can be moved about as required. These engines pump water, drive piles, grind mortar, hoist timber, iron, &c., draw loads, and perform a variety of other operations, in substitution of manual labour.

A temporary bridge, carrying a railway, has been thrown across the whole breadth of the Dnieper, and is connected by a self-acting inclined plane with the heights of Kieff, whence the great blocks of granite and masses of iron are sent down from the depôts above to the works on the river. The great provision of granite, bricks, timber, cement, lime, field-stones, &c., is very extraordinary, covering many acres of ground. A whole village of warehouses, offices, shops, sheds, dwelling-houses for the superintendents, and comfortable cottages for the numerous workmen, have been erected on the left bank of the river, on ground expressly raised for the purpose above the flood level. A regular commissariat is attached to the establishment, and the whole organization of service is very complete. The bricks employed are very hard, and of a beautiful pale colour. Extensive quarries of granite were opened in a great many places, solely for these works, but the principal supply and the largest and finest blocks are found nearly 100 miles from Kieff, and are brought thither on bullock-carts, through a rough country, destitute of roads. Not the least remarkable part of the establishment is that for the manufacture of the hydraulic cement required for the foundations and masonry. It is, in fact, an artificial pozzolano, made from a peculiar clay found in the Kieff hills, and prepared on the principles laid down by the celebrated French engineer, Vicat, in his recent publication. The buildings for this purpose are very extensive, being gigantic laboratories, where the operations are carried on day and night. Eight large roasting ovens, besides numerous grinding mills, are in constant action; the quantity manufactured is upwards of 300 bushels (or about 500 cubic feet) in every 24 hours.

It must be reserved for a technical publication to enter into all the engineering details of construction of the Kieff bridge, as there can

only be given here a merely general idea of the principal features of this very magnificent bridge, which will be the largest in Europe, the length being fully half an English mile, and covering an area of 100,000 square feet, being considerably more than three acres. The works were first commenced in April, 1848. The ceremony of laying the first stone took place in September of the same year. Eight large coffer-dams were completed by the early part of 1849; two of these having been destroyed or damaged by the spring floods, have since been entirely reconstructed. The foundations of the abutments and of two of the river piers were safely got in before the winter began and all the foundations and coffer-dams have been secured by an extensive system of protecting works of *mattrasse-nascines*, laid down according to the modern practice in Holland, by Dutch contractors brought purposely to Kieff by Mr. Vignoles. It is expected that in the course of the autumn of 1851, the Kieff suspension bridge will be finished and opened.

The beautiful model of this remarkable bridge is on a scale of about 1-100 of the length of the actual work. It is the most perfect thing of the kind, probably, ever designed or executed, and reflects the highest credit on Mr. James, of London, the modeller, and his chief assistant, Mr. Sims, who, with another engineer, came purposely from London to erect the model at St. Petersburgh. Every piece of wood or iron, every bolt, screw, and plank—and they are there by thousands—is represented in miniature and in the most perfect manner: the architectural details of the masonry, the interior arrangements of the abutments, the moorings, and saddles of the chains, the machinery of the swivel bridge—all are faithfully represented on the proper scale, and in due proportion. The proportionate scale of length being as 1 to 100, that of area is of course as 1 to 10,000, and that of cube as 1 to 1,000,000! and all the smaller pieces of iron are accurately put into the model in the latter proportion. The stand for the model is of mahogany, supported on bronze Ionic pillars, with gold capitals and frieze, forming a splendid piece of furniture, worthy even of the Imperial Palace. The water of the Dnieper is represented by a mirror, which reflects the under side of the platform, and the whole model is covered with a splendid glass-case, set in a gilt frame, with a beautiful dome of glass, supported on richly gilt pillars of the Corinthian order; the whole exquisitely chased. The model and stand have required two years to make, and the expense, from first to last, has been fully 6,000*l*. sterling.

The cost of the Kieff suspension bridge, exclusive of the approaches, will be upwards of 400,000 guineas—say about two millions and a half of silver roubles of Russia, and nearly 11,000,000f., which, though large in amount, may be considered a very low price for so large a work. Mr. Vignoles has already prepared, by command of the Emperor, designs for several other large bridges in various parts of Russia. Some of them have been approved, and others are still under consideration, and designs are in various stages of progress for still more bridges, besides other works; for all of

which the iron must be furnished from the English manufactories. An engraving of the Bridge, completed, has appeared in No. 414 of the *Illustrated London News*.

VICTORIA SUSPENSION BRIDGE.

THIS new Bridge, (Dredge's Suspension), is thus described:—A stone bridge at Lochy Ferry was estimated to cost 8,000*l*. But it was to be composed of many arches, and as many piers in the river, obstructing its impetuous current, and probably damaging the valuable salmon fishings. The object is now attained with a level iron bridge, at a cost of less than 2,000*l*., without the least obstruction to the current, whereby the liability of ever being overturned by flood or storm is avoided, and, consequently, its *first* will be the *principal* cost. The span of the bridge is 250 feet; platform nearly 17 wide; clear roadway 15; the masonry at the base 28 feet by 16 feet, and built solid up to the roadway 19 feet high, above which each arched entrance is 12½ feet wide and 20 feet high; and the top of the piers upon which the chains rest is 24 feet above the roadway, and the whole tapers three-fourths of an inch to the foot in elevation, excepting four feet of plumb which supports the arches. It is built of the best granite, of rock-work, without a tool-mark visible above the road. The care and attention of the workmen were devoted to making good beds and joints for the substantiality of the structure. The versed sine of the bridge is one-tenth of the chord line, and it consumed 40 tons of wrought and cast iron. The section of the four chains at the top of the piers is 50 inches, which taper to O at the centre of the bridge; hence its strength for transit use is 250 tons, namely, about one-third of its ultimate power. The platform contains 3,600 feet of surface, which will admit of 360 head of cattle being upon it at one time, and this will be the heaviest load to which it will be subject. Now, allowing each to weigh 4 cwt., the load will be only 72 tons, which will leave a surplus power of 178 tons. The foundation stone was laid on the 6th of August last, and, deducting the time lost by inclement weather and short days, the bridge was only three months in building. The first bridge on this plan was the Victoria, in Bath, erected in 1836, and now there are nearly fifty.

GREAT ARTESIAN SALT SPRING AT KISSINGEN.

ON August the 12th instant, says a letter from Kissingen, dated the 17th, the curious spectacle was exhibited to us of a column of water, four inches in diameter, springing with a prodigious force out of the earth to the height of 58 feet from a depth of 1,878½, spreading out like a graceful palm-tree at its highest point, and forming the finest and most striking *jet-d'eau* of this kind ever beheld. The water, as clear as crystal, issues from the soil with a temperature of 66° Fahrenheit, charged with 3¼ per cent. of pure salt, at the rate of 100 cubic feet per minute. This is the result of seven years' Artesian borings, conducted by the able engineer, Mr. Inspector Joseph Knorr.

It will be in the recollection of our readers, that after much patience and labour, M. Mulot, on the 26th of Februry, 1841, drew out of a depth of 1,500 feet, a jet of 3,000 cubic meters of warm water (80 F.) per hour, which has ever since served to supply an extensive district in Paris with that important fluid. The French *savans* declared at the time that M. Mulot's operation was *une des plus éclatantes de ce genre.* But the great Artesian fountain now disclosed at Kissengen, both in its physical characteristics and its economical importance, leaves that of Grenelle far behind. One only other such Artesian spring has been completed within the last two years, at Preussich Munden, in which the salt water is drawn from a greater depth, but rises to an elevation of 15 feet only, and is not so intensely salt.

The saline valley in which Kissingen is seated stands at an elevation of 650 feet above the level of the Baltic sea. The stratification of its rocks from the surface downwards, as it has been revealed to us by the successive borings, is extremely simple. The boring implements first went through 1,240 feet of variegated sandstone, then through 350 feet of sandstone of the Vosges formation, next through 150 feet of Magnesia limestone (Zechstein), and lastly through 138½ feet of rock salt ; thus reaching a total depth, as before stated, of 1,878½ feet. In the latter, or rock salt stratum (which is presumed to be 1,000 feet thick) a pure saline source (Soole) is formed by solution of the rock salt in water. This solution has been found to hold not less than 27¼ per cent. of salt, and as there is little likelihood that they would be able to penetrate into the rock beyond 30 feet deeper, to that extent the perforation is to be pushed, and the well completed by the end of this year.

In August last, the supply of water was at the rate of 100 cubic feet per minute, and the force with which this quantity was ejected to the height already stated was due to a source of almost entirely pure carbonic acid gas, which, having been met with at the depth of 1,680 feet from the surface (at the junction of the gypsum and zechstein), escaped with prodigious force into and out of the Artesian bore-hole, propelling the superincumbent column of water into the air in the manner above mentioned.

In the course of the boring operations two distinct salt wells were gone through, at 222 and 1,240 feet depths, with the respective temperatures of 50° and 66° of Fahrenheit, and 1¼ and 2½ per cent. of salt. It was under both these wells, at the depth of 1,680 feet, that the great carbonic acid gas stratum was first tapped. This stratum of gas would seem to be equally spread under and throughout the breadth of the valley, imparting its peculiarly piquant and pleasant character to the several mineral springs of this spa, described in my recent volume on Kissingen ; and in an especial manner to the Ragozi and Maxbrunnen waters, now become universally known, and the last mentioned of which unquestionably deserves to take the place of Seltzer water as an agreeable andrefreshing beverage.

But the presence of so enormous a quantity of gas giving rise to

an extraordinary commotion in the bore-hole soon proved an impediment to the further extension of the latter. This induced Inspector Knorr to have recourse to a new and simple contrivance of his own invention (which he strongly recommends to the attention of all engineers engaged in the like operations), by which he can arrest, whenever it suits his purpose, and in less time than these few lines have been written, the flow of the gas into the Artesian bore by compelling that elastic fluid to disperse itself through its subterranean recesses whilst he proceeds downward with his work of perforation. When the entire work shall have been completed, 3¾ cubic feet of brine per minute, free from iron and all other impurities, capable of yielding 50lb. of crystallized salt, will be conveyed to the boiling house for crystallization, carrying with it a temperature of as much as 92° of Fahrenheit, which it will bring up from a depth of 1,900 feet. It is, however, intended to limit the whole annual produce of salt from this source to 6,000,000lbs., which at the current market price will add to the revenue of the crown of Bavaria 300,000 florins, after deducting 60,000 florins for yearly expenses of work, fuel, and management.

The whole cost of this great Artesian work, from first to last, will amount to 80,000 florins (6,666*l.*) including all the requisite pumps, pipes, and pavilion to be erected. It was begun in the shaft of an old well, called the Schonborn, in 1832, from which time, and during a period of 11 years, 800 feet only were bored through the rocks, the operation being often interrupted, and even suspended, from a feeling of discouragement. But in 1843, Inspector Joseph Knorr, confidently predicating an ultimately successful result, advised the Government to resume operations, which have never since then been interrupted, either by day or night.

THE CONWAY AND MENAI TUBULAR BRIDGES.

PROF. COWPER has illustrated to the Royal Institution, the economy and structure of these vast Bridges. The Professor commenced by briefly distinguishing between the real tubular structure of Stephenson and certain foreign bridges, from which, it had been alleged, that principle was taken. Thus, the wooden bridge at Schauffhamsen, which was destroyed by the French in 1790, and which was supposed to have suggested the tubular form, is proved by a model now in the museum of King's College to have been simply an arched bridge, having a roof as a shelter from rain. The same remark is equally applicable to a bridge at Wittengen and to wooden bridges in America, where the roadways are roofed. The Professor then read a brief notice of various proposals and estimates, by which it appeared that the attention of the Legislature had been directed to the urgent necessity of a safe transit over the Straits of Menai since the year 1783. The most elaborate report was furnished by the late Mr. Rennie, who supplied several designs and estimates for bridges, either of cast-iron, or partly of cast-iron and partly of stone.

Professor Cowper then proceeded to explain and to illustrate by models the principle of a bridge. He showed that the force exerted on the arch bridge is that of *compression* only—in the suspension bridge the force exerted is that of *extension* only; and that in the bow-and-string bridge both extension and compression are exerted. It was shown that the same forces are are also exerted on the girder —viz., extension on the under and compression on the upper side. This was demonstrated by the following experiment: Wood, tin plate, and tin tubes, were successively inserted in a space of about four inches, purposely cut for that purpose in the middle of a girder, where it was also jointed. When the tin plate was inserted in the upper side, it bent under the pressure of a few pounds; but when rolled up into a tube, it supported more than 100lb. Again, when the same piece of tin plate was fixed to the under side of the girder, where the force of extension was called into action, it would have required several hundred-weights to have torn it asunder. Mr. E. Hodgkinson's experiments on the best form of section for cast-iron girders were then adverted to. Small experimental girders, devised by that gentleman, were shown. They resemble the letter T. It was stated that the strength of this girder, when the flat side was uppermost, was to its strength when inverted, ⊥, as 1 to $3\frac{1}{4}$. Other forms of section showed that the distribution of the same quantity of material would give differences in strength varying as $5\frac{1}{2}$, 11, 15, 19.

It was then explained how wrought-iron tubes had been employed by Locke, Brunel, and Fox and Henderson, in the bow of bow-and-string bridges, and by Fairbairn in girders. The insufficiency of ordinary suspension bridges to support railway trains was adverted to; and Mr. Cowper explained a perfectly novel and highly scientific design of a railway suspension bridge, the invention of his son, Mr. E. A. Cowper. This bridge, from the principle of its construction, is called "The inverted arch bridge." An arch of an ordinary cast-iron bridge (like the Southwark Bridge) is secure in whatever position the load is placed, because the lines of thrust are contained within the arch of plates. Now, imagine a similar arch of wrought-iron plates to be inverted, and a road-way hung to it, then, wherever the load may be placed' the lines of strain will also be contained within the inverted arch of plates, and consequently there will be no deflection of the road. This very original invention is worthy the attention of engineers.

Prof. Cowper then explained Mr. Stephenson's original proposal to build, without interrupting the navigation by scaffolding, a bridge of two cast-iron arches, the centre pier being placed on the Britannia rock. It was shown by a model how two half arches could be built on the opposite sides of a pier, each being tied to, and so balancing, the corresponding voussoir on the other side. Other conditions imposed by the Admiralty, but incompatible with the plan of the railway, induced Mr. Stephenson to adopt the plan of a vast tube. A section, made of rope, comprising the full size of the tube,

was suspended from the ceiling of the theatre of the Institution : it was 15 feet wide and 30 feet high ; and Prof. Cowper stated the length to be 460 feet (about twice the height of the Monument). After many experiments on cylindrical, elliptical, and other forms, Mr. Fairbairn adopted that of a rectangular tube, with rectangular cells at the top. Prof. Cowper illustrated, by experiment, the necessity of stiffness at the top of the tube, and demonstrated that this was obtained by the cellular form. The Menai tube is made with wrought-iron plates varying from $\frac{5}{8}$ to $\frac{3}{4}$ of an inch in thickness, firmly rivetted together with T or ⊥ iron at the joints. The rectangular cells at the upper side are eight in number, and are 1 foot 9 inches square; and there are six similar rectangular cells at the bottom of the tube. The method of putting the tube together, and of raising it by hydraulic presses, was explained and exhibited by a model. The bridge consists of two lines of tube, extending over two centre spans of 460 feet each, and two smaller spans of 230 feet each. These tubes, when in their places, were joined together by intermediate tubes of about 50 feet over the piers ; thus, not only making the length of one entire tube to amount to 1,524 feet, but by the junction adding considerably to the strength. The weight of the tubes is about 10,570 tons.

The Conway tubular bridge has been in use for some time, and it is found that an ordinary train deflects the tube about $\frac{1}{8}$ of an inch ; that hot sunshine causes the heated side to bow out about 1 inch ; that the strongest wind deflects the tube about 1 inch. It is intended to put sliding stays between the up-train and the down-train tubes of the Britannia Bridge, so that they will support each other against the wind. The difference of temperature between summer and winter will expand the entire Britannia Bridge about 12 inches : this is provided for by fixing the middle of the tube on the Britannia pier, and allowing the ends to rest on forty-eight rollers, about 6 inches diameter in the abutments : the rails in those parts being allowed to slide by each other.—*Athenæum*, No. 1164.

SIR F. C. KNOWLES'S IMPROVEMENTS IN THE MANUFACTURE OF IRON.

The problem of the successful reduction of the rich primary ores of Iron has at length been solved. This has been accomplished with the peat coke of Dartmoor, by Sir Francis Charles Knowles, Bart., and a peculiar process of his own invention : its extraordinary power will be appreciated when we state that the pressure of the blast used at no time exceeds 6 oz. to the square inch : yet this is found adequate to bring down, with profuse rapidity, a rich gray cast-iron. The iron produced is uncommonly strong, yet soft and ductile under the hammer, and, in its fracture, presents the valuable peculiarity of a highly homogeneous structure. It has been submitted to competent judges, and pronounced to be of very superior quality, worth, at the least, from 5*l.* 10s. to 6*l.* per ton ; and we are

given to understand that iron of a much higher value can be produced by the process of Sir Francis.—*Mining Journal.*

This important Improvement is detailed and illustrated in the *Mechanics' Magazine.*

COMPARATIVE ELASTICITY OF WROUHT AND CAST IRON.

THE mean ultimate resistance of Wrought Iron to a force of compression, as useful in practice, is 12 tons per square inch, while the crushing weight of cast iron is 49 tons per square inch ; but for a considerable range, under equal weights, the cast iron is twice as elastic, or compresses twice as much as the wrought iron.

A remarkable illustration of the effect of intense strain on cast iron was witnessed by the author at the works of Messrs. Easton and Amos. The subject of the experiment was a cast iron cylinder $10\frac{5}{8}$ inches thick, and $14\frac{1}{2}$ inches high, the external diameter being 18 inches.

It was requisite for a specific purpose to reduce the internal diameter to $3\frac{1}{2}$ inches, and this was effected by the insertion of a smaller cast iron cylinder into the centre of the large one : and to insure some initial strain, the large cylinder was expanded by heating it, and the internal cylinder being first turned too large, was thus powerfully compressed.

The inner cylinder was partly filled with pewter, and a steel piston being fitted to the bore, a pressure of 972 tons was put on the steel piston. The steel was "upset" by the pressure, and the internal diameter of the small cylinder was increased by full three-sixteenths of an inch—*i. e.* the diameter became $3\frac{11}{16}$ths of an inch! A new piston was accordingly adapted to these dimensions, and in this state the cylinder continues to be used, and to resist the pressure : the external layer of the inner cylinder was thus permanently extended $8\frac{1}{50}$ths of its length. In fact, it can only be regarded as loose packing, giving no additional strength to the cylinder.

Under these high pressures, when confined mechanically, cast iron, as well as other metals, appears, like liquids, to exert an equal pressure in every direction in which its motion is opposed.—*Clark, on Britannia and Conway Tubular Bridges.*

DEFLECTION OF IRON GIRDERS.

IT is considered that Girders should not deflect more than from $\frac{1}{600}$th to $\frac{1}{400}$th of their length according to the form of the girder. It does not appear, from the evidence given before the Strength of Iron Commission, that a weight equal to what a girder is constructed to carry will, even if left on for any length of time, cause the deflection of the girder to increase, unless subjected at the same time to considerable changes of temperature. Some experiments made by Mr. Fairbairn and Mr. Braidwood show that iron loses a considerable proportion of its strength when heated to a temperature of more than 220° F., and that it becomes uncertain below 32°. Mr. Clark described the effect of the sun coming out and shining

on the Conway tubular bridge for half an hour have been to raise the tube vertically one inch; and he mentions that at night, from the lower temperature, the deflection was always greater than in the day-time. Mr. Fox instances the effect of frequent and great changes of temperature on some short girders, 6 feet long, which support the hoods of the forges of his workshops. In the day-time they are so warm that the hand can only just bear the heat, and at night they become cold. The effect is to make the girders *swag*, and the swagging appears to be continually increasing. Some have attained as much as 3″ deflection in the centre, but their strength does not seem to be impaired. The general opinion as to the amount of test which should be applied to girders appeared to be, that the test should amount to twice the greatest load. Mr. Joseph Cubitt would employ three times the greatest load, or half the breaking weight: and Mr. Thomas Cubitt considers it safer to test a girder almost to the extent that would break it, than not to prove it at all, as the testing of girders is the only means of discovering defects under the surface and concealed from the eye. Mr. Brunel, however, thinks that a girder should not be tested with a weight exceeding the greatest load, as the object in testing is to ascertain the soundness of the casting, which may be judged of by its appearance under the load, and all risk of permanent injury should be carefully avoided.—*Builder*, No. 366.

APPLICATION OF IRON TO RAILWAY STRUCTURES.

In August, 1847, a Royal Commission was issued, appointing Lord Wrottesley, the Rev. R. Willis, Captain James, Mr. George Rennie, Mr. William Cubitt, and Mr. Eaton Hodgkinson, Commissioners, and Lieutenant Douglas Galton, of the Royal Engineers, as Secretary, to inquire into the effect of concussion and vibration upon the strength of cast-iron, and to examine the action of weights moving over bridges subject to deflection compared with the action of the same weights at rest. The sum of £3000 was placed at their disposal for experiments. The chief results of the Inquiry have already been given in a lecture delivered by Mr. Willis, before the British Association, at Birmingham. The Report, which has since been printed, will be found to contain some useful information on a subject upon which in practice engineers at present are unable to apply principles with confidence.

The Commissioners, in the first place, direct attention to the following general conclusions arrived at from the experiments made, and the information collected by them in the course of the inquiry:—"That it appears advisable for engineers in contracting for castings to stipulate for iron to bear a certain weight, instead of endeavouring to procure a specified mixture. That to calculate the strength of a particular iron for large castings the bars used as a unit should be equal in thickness to the thickest part of the proposed casting. That, as it has been shown that to resist the effects of reiterated flexure, iron should scarcely be allowed to suffer a deflection equal to

one-third of its ultimate deflection, and since the deflection produced by a given load is increased by the effects of percussion, it is advisable that the greatest load in railway bridges should in no case exceed *one-sixth of the weight which would break the beam when laid on at rest in the centre.* That, as it has appeared that the effect of velocity communicated to a load is to *increase the deflection that it would produce if set at rest upon the bridge;* also, that the dynamical increase in bridges of less than 40 feet in length is of sufficient importance to demand attention, and may even for lengths of 20 feet become more than one-half of the statical deflection at high velocities, but can be diminished by increasing the stiffness of the bridge; it is advisable that, for short bridges especially, the insreased deflection should be calculated from the greatest load and highest velocity to which the bridge may be liable; and that a weight which would statically produce the same deflection should, in estimating the strength of the structure, be considered as the greatest load to which the bridge is subject. Lastly, the power of a beam to resist impact varies with the mass of the beam, the striking body being the same, and by increasing the *inertia* of the beam without adding to its strength, the power to resist impact is within certain limits also increased. Hence it follows that weight is an important consideration in structures exposed to concussions."—*Builder*, No. 400.

IRON PERMANENT WAYS.

A SERIES of experiments has been carried out by Mr. P. Barlow, C.E., from which he has been led to recommend the substitution of cast-iron in place of wood in laying the substructure of Permanent Ways, as the only means of preventing those irregularities of surface which cause blows to be given by the engine that are not only annoying to passengers, but further and more and more rapidly destructive to the way and to the carriages, as well as wasteful of the locomotive power and mechanism. The present practice he regards as temporary way much more than permanent. Mr. Barlow finds it to be a mistake, that a partially soft elastic material such as wood is requisite to smooth and easy motion: the more rigid, and level, and polished, the surface, the easier has he found the traction, and the better suited at least to railway transit. Cast-iron sleepers in two halves, with half chairs fitting the rail, and bolted together so as to avoid the use of the key, is that construction of substructure to which experiment has led him to yield the preference, from the facility with which it is laid, from the perfect joint which it gives, and the security from breakage in the event of getting off the line. The point of the meeting of the plates is situated between the chairs, so that the bolts act under a spring which destroys all liability of loosening, to which he has not found any tendency.

THE GREAT GUN OF BEEJAPORE.

IT is stated to be the intention of the British Government to have

the Monster Brass Gun at Beejapore removed to Bombay. The weight of this enormous weapon of destruction is 41 tons, which we should think could never be very manageable in the hands of any natives of India; and yet they seem to have contrived the means to convey it from where it was manufactured to Beejapore. This gun is one of the trophies of the late Mahratta war, and will most likely reach England in time for the Industrial Exhibition, at which it may be exhibited. It appears that Government entertained the idea of its removal so far back as the year 1825, but, considering the large outlay which the measure would require (some fifty thousand rupees) the matter was dropped. Since that period, however, our "scientific" or other resources are so developed, as, we should suppose, to considerably reduce the expense of the transit, and to facilitate that to which there formerly existed obstacles not now to be seen.—*Bombay Times*, June 18.

COATING FOR CAST-IRON.

Mr. W. Wyatt, of Oldswinford, has patented a Glaze,—three parts, by weight, of white-lead, or one part red, or two white, to two borax, and one calcined flint, to be fused, run into water, and ground in a glaze mill to the consistency of cream. The article coated is to be placed in a kiln—no part of the glaze furnaces exposed to flame or sulphur—and heated till the glaze melts.

EFFECTS OF SHOT ON IRON SHIPS.

"The first experiment for testing the Effect of Shot and Shell on the sides of iron vessels, lately took place at Portsmouth, under the superintendence of Capt. Chads, on board the *Excellent*. The Commander-in Chief, Admiral the Hon. Sir Bladen Capel, Rear-Admiral Prescott, and a number of naval and military officers, were on board her. A large butt, being a copy of a section of the *Simoom's* main deck, had been made in the dockyard, representing the two sides of an iron vessel, each side of the strength and consistency of one of the large iron steam-ships. This butt was erected on the mud, at a distance of 460 yards from the *Excellent*,—and the practice took place at high water; from guns of several calibre and various charges of powder, both shot and shell were fired. At intervals between the firing, boats visited the butt, to examine the effects of particular shot on the iron work. It was found that, on the side which the shot entered, a large and tolerably round hole was made in the iron plate, the circumference being much jagged, and the edge turned inward. On the opposite side, where the shot passed out, the hole was larger, and also jagged, the edge of the whole turned outwards, with occasionally some rivets started. Some of the shot on entering, and from striking against the angles of the iron ribs, were broken in pieces, the fragments passing out at the opposite side, making holes of various sizes and formations. Shells also appeared to have a destructive effect on the iron-work in creating splinters, and the pieces of shell passing out through the plates at the opposite side—the off side in all cases suffering most. Of course, neither shot nor shell, nor grape nor canister, would lodge in iron vessels, as would be the case in wooden vessels. To test the effect of the splinters inside the vessel, a slight plank bulkhead had been run up between the iron sides of the butt. This was found entirely shattered."—*Newspapers*.

The above cited experiment, made at the suggestion of Admiral Sir

Charles Napier, cannot but be considered as of vast importance to the mercantile no less than to the military marine; since it goes to establish that, not only the hull of an iron vessel would be subject to great danger in action with an enemy, but also that her sails, rigging, interior fittings, and crew, would be destroyed by splinters of metal.

On reference to No. 1313, p 353, of the *Mechanics' Magazine*, it will be seen that the recent experiments at Portsmouth are such as were recommended to the Comptroller of the Navy by Sir Samuel Bentham, so long ago as the year 1810. Then, at the same time that he was indicating that navigable vessels had been already built of metal, and that he was of opinion that this material "might be largely employed in the construction of ships for the navy," Sir Samuel represented that "the effect of *shot upon metal* is a point which would require experiments, in order to ascertain the difference that would result in consequence of the non-elasticity of metal when struck by shot; particularly in regard to the size and shape of the aperture made, to what extent beyond it the metal would be likely to be torn, the kind of splinters that would be carried within board, &c. Such experiments would be easily made by firing shot of different sizes, and with different velocities, against plates of metal of different kinds and different thicknesses; which plates, however, should be affixed to a body floating upon water, in order that they might have the same advantage of that slight recoil on the water which would exist in regard to metals employed in vessels for sea service."

The recent experiments at Portsmouth seem to leave no room for cavil, excepting that the butt was a *fixed* one on the mud, so that it was deprived of "the advantages of slight recoil;" and as the Committee on Navy Estimates, 1848, reported that officers who had commanded iron steam-vessels under fire were "unanimously in favour of their fitness for war," it still seems desirable that further experiments should be made against a butt floating on water. The question, however, seems to have been virtually set at rest by the Portsmouth experiments; and had Sir Samuel's proposal in 1810 been adopted at that time, instead of this late day, the nation would have been saved not far from a million sterling thrown away, it may be said, on iron vessels of war.

The importance of the recent experiments at Portsmouth to the *mercantile* marine is confined to periods of hostility with foreign nations; but in times of war, in what seas would iron built vessels venture? The stroke of a single shot against an iron hull would amount to almost certain perdition, and rather than run the risk, her colours would be struck on the first summons of an enemy, No longer would a coaster, if of iron, hazard a combat in self-defence; the always heavy item of insurance during war would of course greatly exceed for an iron vessel the rate thought sufficient for one of wood. In regard to the auxiliary defensive force of the country now counted on as surely available from the mercantile

marine, it could no longer be depended on from such portions of it as are built of iron.

In the Portsmouth experiments, as stated above, there is a circumstance which points to the need of further trials to ascertain the fitness of iron for such parts of a vessel as her timbers or beams. The *plates* of iron were always pierced by shot and shells, so that no doubt remains on this head; but where a missile struck against *angle* iron it was the *ball* that was broken into splinters.—*Communicated to the Mechanics' Magazine*, No. 1404.

HOW AMERICAN AXES ARE MADE.

The process has been greatly simplified within the last two years. The iron is rolled out into bars the proper width and thickness of an Axe, and 6, 8, and 10 feet long : it is heated and cut off by a large pair of shears propelled by water power: another workman picks up the piece and places it between a die and punch, and the punch comes down and forces the hole for the handle by punching out a piece. An iron mandrill is then inserted into the hole, and it is immediately put under another press, which forms one side of the axe; it then goes into another die, and forms the other side, and is then placed in an upright position, and a chisel comes down and splits the "bit" of the axe ready for the steel: it is then thrown aside. All this is done at one heat, and in less time than it takes to write the *modus operandi*. The blade of the axe is then put in and welded, and passed along to the forger, tempered, and cast upon the ground to cool. As soon as cool it is taken up and planed down to an edge by a planing machine, and finished up with the emery wheels—painted, labelled, stamped, and ready for market.—*American Paper*.

CAST-IRON LIGHTHOUSE, IN THE BERMUDAS.

The form of this tower, erected on Gibbs Hill, is that of a strong conoidal figure, 105 feet 9 inches in height, terminated at the top by an inverted conoidal figure, 4 feet high, in lieu of a capital; its extreme outside diameter 24 feet, at the narrowest part 14 feet, and at the top 20 feet. The external shell is constructed of 135 concentric cast-iron plates, having inside flanges, and varying in thickness from 1 inch at the base to about $\frac{3}{4}$ of an inch at the top. In the centre of the tower there is a hollow cast-iron column, 18 inches in diameter in the inside, and of $\frac{3}{4}$ inch metal, for supporting Fresnel's dioptric apparatus, and in which the revolving weight descended; it was also used, in the daytime, for the raising and lowering of stores, and likewise contained the waste-water pipe. The lower part of the tower is filled with concrete, leaving a well, faced with brickwork, about 8 feet in diameter, and 20 feet in depth, in the centre. Above this are the seven floors, the two lower ones being lined with brickwork, and used as store rooms, and the upper ones, lined with sheet iron, used as living rooms for the light-keeper. The structure occupied about one year in its erection, the different parts having been

landed about the end of November, 1844, the first plate being erected on Gibbs Hill, on the 19th December, 1844, and the last plate of the tower on the 9th of October, 1845. The whole cost of the structure, including the lantern and light apparatus, is stated to have been about 7,690*l*., and the annual expense of maintaining it about 450*l*.

THE FASTNETT ROCK LIGHTHOUSE.

THIS noble work is nearly completed. Its engineer and designer is Mr. George Halpin, C.E., of the Dublin Ballast Corporation, under which body it was contracted for. The whole shell is of iron. The tower, above 25 feet diameter at base, and above 80 feet in height to gallery floor, is composed of plates of cast-iron of nearly 1½ inch in thickness, flanged-jointed; all exactly jointed by the planing-machine, and bolted together. This great conical tower is surmounted by a bold projecting cornice and gallery, above which the tower again rises some feet. The whole structure internally is lined with brickwork and masonry, the floors of stone, and the staircases, from loft to loft, of cast iron. Through the centre descends a hollow column of cast iron, to allow the movement of the great weight which is to keep the revolving light in motion. The whole is bolted down at base to the solid rock, and further steadied by being filled up solid to some height with masonry. As absolutely an Irish work—designed by an Irish engineer, and executed (without the alteration of a line from the original contract designs) by an Irish firm, and by native workmen erected on the most southerly spot of Irish land—it is likely to stand for ages an object justly of some national pride.—*Inspector.*

IRON HOUSE-BUILDING.

THIS novel mode of construction proceeds rapidly. Mr Walker, of Gracechurch-street, has shipped for Port Natal, a spacious Hotel, of corrugated iron, one of the largest structures yet manufactured of this material. It has a frontage of 78 feet; the depth is 60 feet; and it contains twenty large rooms. The hall is 10 feet wide, 60 feet long, and 25 feet high. To the right is a club-room, 44 feet long, and 24 feet wide, which can be divided by folding-doors into two rooms. Behind this room are the three kitchens, 12 feet by 14 feet. To the left of the hall are the bar, bar-parlour, sitting-room for the family, and bed-rooms; also, bed-rooms for the visitors: in all, fifteen rooms. At the extreme front of the building is attached the tap-house, a building 40 feet long, and 20 feet wide; behind which are two wash-houses. The whole will be completely floored and ceiled when at Port Natal.

Mr. E. T. Belthouse, of Manchester, has completed two large houses for California, &c. The frame-work and sides are made of iron, corrugated in order to impart to them additional strength. One of the houses consists only of a single story, containing a sitting and bed-room. The walls, floor, and ceiling, are boarded entirely

over, and the interior thus possesses an air of comfort. The sitting-room measures 11 feet by 6, and is 8 feet 3 inches in height. It is furnished with a stove of an improved description. The value of this house is 90*l*. The second house is of two stories, and contains, altogether, eight rooms,—three parlours, and a kitchen below, and four bed-rooms. Each of the two front parlours (one being on either side of the door) is 12 feet square; while the two back rooms measure 12 feet by 10, the height being proportionate. The bed-rooms are exactly the same size as the lower apartments, with the exception of one, which, extending over the lobby, measures 14 feet by 12. The sides, floors, and ceilings, like those of the first house, are boarded and painted. The value of the latter house is 460*l*.

Messrs. M'Kean and Perkes, of the Victoria Works, Birkenhead, have constructed and shipped for California, a large iron house, in which the principle adopted is novel, and combines the greatest degree of strength with the smallest possible quantity of iron. The framing is of "T" iron, not unlike that used for ordinary deck-beam purposes, but it is so arranged as to clip the plating, all of which is of corrugated galvanized iron, but so placed as to give the house the appearance of being formed of latticing on the Venetian principle. The internal appearance of the rooms is most novel and effective: in one of them a *déjeuner* was served to 200 guests. The cost of this erection is about 2000*l*.

NEW ROOF AT EXETER HALL, STRAND.

WITH the view of improving Exeter Hall as a music room, and place for public speaking, very considerable alterations have been made, under the direction of Mr. S. W. Daukes, architect. The works are novel and ingenious.

The pillars with the entablature above supporting the hip trusses at either end of the hall, which curtailed the length nearly forty feet, have been entirely removed, so that the whole area of the hall is now thrown open. The flat panelled ceiling was removed, and the hall within the four outer walls is now covered with a covered ceiling, twelve feet higher in the centre than the former flat ceiling, all which has been done without disturbing the slating of the roof. It was a bold idea, and was effected by the introduction of wrought-iron arched girders, composed of plates varying in thickness from half an inch to a quarter of an inch, with angle iron at the top and bottom, stiffeners of strong T iron, and plates to cover the joints. These girders, put up in three pieces, were raised and supported in their places from the tie-beams of the roof, and were then riveted together with red-hot rivets, a furnace for that purpose having been erected in the roof. The ends of the girders were then supported upon smooth greased iron plates, to allow of the spread corresponding to the deflection of the arched girder without causing a thrust, or affecting the walls. Each girder, when it had been completely put together, and quite independent of any part of the old roof (which remained intact), was weighted with upwards of seven tons,

the weight it would have to support, which was distributed over its length. The deflection from this process was one inch and an eighth, and the spread of the girder half an inch at each end, which took place on the plates, and so caused no thrust upon the walls. The girders, while weighted, were then bolted to one side of each of the old timber principals above the proposed covered ceiling, and then released of their weight.

Besides these girders there were two independent girders of a stronger construction, and nine smaller ones supporting the hips ateither end; all of which were tested with corresponding weights.

This being done, the whole of the original constructed parts of the roof, beneath the curved line of new ceiling, and consisting of the tie beams, queen post, and struts, were entirely removed, when no visible deflection took place. Ceiling joists were then attached to the girders, and the whole closely boarded over, with the exception of a number of circular openings, one over each chandelier, for ventilation.

The girders were calculated to support a weight of 64 lbs. per square foot, whereas the actual weight on them, we understand, is not more than 45 lbs. and the breaking weight 220 lbs. per square foot. The whole weight of the iron used is 75 tons, which, with the new ceiling, is one-third less weight than the original roof.

Mr. C. J. Mare, of Blackwall, constructed the iron girders, and Mr. G. Myers was the builder employed.—*Builder*, No. 509.

NEW METHOD OF CONSTRUCTING GATES AND DOORS.

We have inspected some models of Gates and Doors constructed on Mr. Shepard's plan. The method he adopts is:—instead of hanging gates and doors in the usual way by hinges, or running them backwards and forwards on wheels, he suspends the gates or doors to iron bars extending over the gate or door. Attached to the top of the gates are two wheels; these wheels rest immediately on the top of the bar mentioned. When it is necessary to open the gates or door, the bar is raised a little in the centre of the doorway by means of turning a key round and round, which unlocks the gate, and at the same time raises the bar sufficiently to form an inclined plane, upon which the gate or door, by means of rollers or wheels, runs back by its own gravity into a suitable recess in the piers or wall at each side made to receive it, and thus opens the gateway clear of all obstruction. When it is necessary to close and lock the gates, the bars upon which the gates hang are depressed a little at the ends, and the gates or doors run along the bars until the gateway or doorway is closed, and the gates locked. It appears that the London and North-Western Railway Company have adopted this plan at one of their stations, and find it to answer much better than the ordinary mode,—this method requiring but one man to open and shut the gates, while in the ordinary plan it required six. We were

shown several testimonials from architects and engineers, recommending the adoption of the invention, from the ponderous gates of a fortress or railway station down to the highly-finished door of a mansion.—*Herapath's Journal.*

NEW DOOR SPRING.

MR. G. BEATTIE has described to the British Association, his new Door Spring, and exhibited one of the springs in working order; the motive power being the pressure of the atmosphere. Mr. Beattie's application of this natural law is simple in the contrivance. When the door is opening, it withdraws a tight piston from the closed end of a cylinder, which leaves a vacuum behind the piston; and the pressure of the atmosphere upon the piston forces it back to its place, and closes the door. This cylinder has an exhausted chamber in connexion with it for giving the door a maintaining power when shut. There is also working with the first cylinder and piston a dwarf cylinder and piston for regulating the speed the door is wished to be closed at, which has perfect control over the travel of the door, either in allowing it to shut at once, or to take any given time. The advantages this door-closer possesses are that the resistance is uniform when opening the door; and when shutting it, there can be no increase of speed beyond that to which it is set, and consequently no slamming noise.—*Athenæum*, No. 1190.

LOCKS AND KEYS.

AN interesting paper has been read to the Institution of Civil Engineers, "On the Construction of Locks and Keys," by Mr. J. Chubb, Assoc. Inst. C. E.

The author commenced by stating, that the most ancient lock, of whose form and construction there was any certain knowledge, was the Egyptian, which had been in use for upwards of four thousand years. The construction of this lock was minutely described, also that of the ancient "warded" and "letter" locks, and considerable antiquarian research was displayed in tracing their origin and introduction. These three kinds of locks are, in principle, the foundation of all modern locks.

In Chubb's lock, first patented in 1818, and since modified and improved by various subsequent patents, there were six separate and distinct tumblers, placed over each other, and capable of being elevated to different heights, but all moving on the centre pin. This lock differed from the others, in having a "detector," by which any attempt to pick, or open the lock with a false key, was immediately notified, on the next application of its own key.

Calculations were then gone into, to show the number of different combinations which might be made in this lock; and it appeared, that with an average sized key, having six steps, each capable of being reduced in height twenty times, the number of changes would be 86,400; that if the seventh step, which threw the bolt, was taken into account, the reduction of it only ten times would increase the

number to 864,000. Further, that as the drill pins of the locks, and the pipes of the keys, might be made of three different sizes, the total number of changes would be 2,592,000. In keys of the smallest size, the total number would be 648,000, whilst in those of the largest size it would be increased to 7,776,000 changes.

The paper was illustrated by a series of diagrams, and a variety of specimens, of the locks and keys noticed in the paper; and also by a number of Gothic locks and keys of very elaborate workmanship, suitable for ecclesiastical buildings, &c., from Mr. Chubb's works, in London.

In the discussion which ensued, many additions were made to the historical part of the subject, and various ingenious contrivances were described, which had been successfully applied, to give increased security to locks of ordinary construction. The combinations in the locks of Summerford, and McKinnon (of New York), were also fully described; an advantage being claimed for the former, in making one tumbler to lift and the other to fall, in order to open it; and, for the latter, that, by the addition of a curtain, of case-hardened iron, three-quarters of an inch in thickness, radiating from the centre of the pin, and a radiating key, there was no means of reaching the tumblers, for the purpose of taking an impression, or otherwise, except by cutting through that curtain. On the other hand, it was positively asserted, that no impression could be taken of, or means invented for, picking a lock which had six tumblers, although it could be easily done, with locks having fixed wards; further, that Chubb's lock was a decided improvement on all others of the same character, inasmuch as it possessed a "detector," which formed really the peculiar feature of that lock; the excellence of the workmanship tending also to the facility of action and consequent durability, for which it was so celebrated.

A NEW LOCK.

Mr Edwin Cotterill, of Birmingham, has invented a Lock, patented as the detector lock, the security of which is alleged to to consist in the peculiar formation of the wards, and a radial spring operated on by a key so cut and adapted as to press unequally on the spring. The nicety observed in the cutting is said to render it impossible even for the maker to produce a key precisely to fit the same lock: the security consists in the impossibility of knowing where the pressure takes place, the key being of the most eccentric form, and the lock, in fact, made to fit the key, not the key to fit the lock. The variations are said to be on the scale of the millionth part of an inch. A key apparently precisely like the true one will throw out a spring called the "detector," which not only makes all the parts fast against the false key, but renders it necessary that a peculiar backward movement be made with the true key before the lock can be opened; hence the title of "detector." Another security is afforded by the formation of the key preventing its being cast.

STEEL WITHOUT PIG-IRON.

An invention has been patented by Mr. Heath for the manufacture of Steel from iron produced directly from the ore without being brought into the state of cast-iron. Ore, as usually reduced to metal, is mixed with a small portion of chloride or oxide of manganese, and some coal or fir tar, or other cheap carbonaceous matter, and heated to a welding heat: it is then compressed into a bloom, re-heated and shingled, hammered, or rolled into bars in the ordinary way; and the bar-iron thus produced is converted into steel by any of the usual processes.—*Builder*, No. 406.

AMERICAN STEEL.

In an American publication, called *The Plough, the Loom, and the Anvil*, there is an interesting article "On the Manufacture of Steel in America, by the Adirondac Iron and Steel Company." It is well known that up to a late period the United States have been dependent on English manufactures for every pound of cast steel which they used, but which will now no longer be the case if the statement alluded to be correct. According to this, the existence of the ores of iron fit for conversion into steel was not known in America; but the Ariondac steel is said to be now equal, if not superior, to English made from Swedish iron. These ores are found in Essex county, New York, in the very heart of the Adirondac mountains, where the proprietors hold about 100,000 acres of land, all heavily timbered, and possessing inexhaustible supplies of mineral treasure. The deposits of ore consist of all the varieties of the black magnetic oxide of iron, associated with beds of limestone, common and fine clays and sand, with veins of quartz. The works are erected on a stream affording water-power to an unlimited extent, surrounded by a dense and unbroken forest in every direction, which has been secured for the purposes of supplying charcoal. The present works consist of black and puddling furnaces, with all the necessary buildings and machinery; and the steel is produced direct from the ore, it not being necessary to bring the iron first into the malleable state.—*Mining Journal.*

MAKING STEEL.

Mr. John Holland, Larkhall Rise, Clapham, has patented a mode of converting wrought-iron articles into steel by exposing them in a furnace to the action of alternate layers of carbonized and uncarbonized materials; the latter consisting of silk-worms, silk cocoons, silk waste, which the patentee torrefies, or highly dries, without carbonization, then reduces to powder, and stores it in air-tight vessels until required for use. When, for instance, it is desired to convert the top surface of rails or ploughshares to the depth of half an inch, the patentee spreads over the surface of an oven or furnace a layer, of an inch deep, of coal-dust, coal-slack, or coke-powder, or of a mixture of these substances, and above that a layer, of equal depth, of the torrefied substance, upon which the iron articles

are placed, with their surfaces to be steeled in contact with the torrefied substance, care being taken to cover such portions as are not to be steeled with clay. The furnace is filled with a series of layers of these different materials, and heated to the ordinary temperature until the conversion is effected, which will be in a much shorter time than has hitherto been practicable, and may be ascertained by testing in the usual way.

To convert iron ore into steel, it is first reduced to pieces of the size of a nut, walnut, or egg, and then well washed to free it from dirt; subsequently it is enveloped in a paste composed of equal parts of clay and slack lime mixed with water, and subjected to heat, after which it is submitted to the above cementing process in crucibles or close vessels.

VISCOUNT DE SERIONNE'S IMPROVEMENTS IN THE MANUFACTURE OF BUTTONS.

This invention consists in the manufacture of Buttons, knobs, or other similar articles, which have hitherto been made from porcelain or China clay,—from crystallized felspar, common felspar, basalt, lava, pumice-stone, granite, sand, and free-stone silex.

The buttons are divided into two classes; "straz," which are transparent, and "agathe" (query, "agate"), which are opaque.

The straz buttons are manufactured from pebbles, of crystallized felspar, which contain as little clay and lime, or lime salts, as possible. These pebbles are reduced to powder by heating them to the degree of temperature known as "rouge cerise" (cherry red), and then plunging them into cold water. The powder is separated from its impurities by being passed through a wire gauze sieve, and is next well stirred in water. The supernatant water is decanted off, and carries with it the clay which was held in suspension; while the residuum is treated with a quantity of hydrochloric acid, varying from 3 to 10 per cent., to free it from the oxide of iron, which would give the buttons a reddish tinge in the baking process; and from the lime or its salts, which would render them more or less opaque. The powder is subsequently washed with water, to free it from acid, until it resists the test of litmus paper, when it is dried. 100 lbs. of the powder is then mixed with 2 lbs. chloride of sodium and 4 lbs. flour paste, dissolved in 5 quarts of water, and the large particles ground small by a wooden roller. This mixture is passed through a sieve, is granulated in the same way as gunpowder, and dried to a proper consistency for moulding.

The agate buttons are made from natural felspar, partly decomposed, but not in the state of "kaolin." It is treated much in the same manner as the crystallized felspar, except that it is mixed with a sufficient quantity of lime, or any of its salts, which are not injuriously affected by heat; such as phosphate, superphosphate, or any of the sulphates, to give it the necessary degree of opacity.

Instead of sodium, the patentee states that barium or strontium

may be used; and that any of the quartzeous sands may be employed instead of felspar.

The moulding-machine consists of a screw press, fitted with levers and other mechanical contrivances. It contains an upper and lower matrix, and intermediate perforated plate, which is charged with the prepared materials. The matrices are then brought together, with the perforated plate between them, and the buttons thereby compressed. The sockets for the shanks, or the holes for sewing the buttons on, are formed by removing the inferior matrix, and lowering the perforated plate on to a number of projecting pieces. An iron frame, supporting a sheet of paper, is then introduced under the perforated plate, and the buttons deposited thereon by depressing the upper matrix, so as to force them through the holes in the intermediate plate. The sheet of paper with the buttons on it, in the same order which they occupied while in the mould, is then placed on a red-hot earthenware plate, which burns the paper, and retains the buttons. These plates, with the buttons on them, are then placed in a like number of elliptically-shaped muffles, which are arranged in such manner inside an oven as to allow the products of combustion to play around them, and impart an equal quantity of heat on each side.

To fix the shanks in the sockets, the patentee employs one of the following vitrifiable cements :—

1.	Fritted agate substance	100 parts	very hard.
	Crystal	50 ,,	
2.	Fritted agate substance	90 parts	fusible.
	Crystal	15 ,,	
3.	Fritted agate substance	60 parts	very fusible.
	Calcined at 25 per cent. of pewter	60 ,,	
	Crystal	10 ,,	

It is proposed to ornament the buttons by first covering them with a mordant, such as linseed oil, &c., and then dipping them into a powder of any of the suitable metallic oxides; after which they are to be baked: or, by coating them with an enamel composed of 300 parts crystallized felspar, as free as possible from iron; 400 parts minium, as pure as can be obtained; 200 parts pure calcined nitre, and 100 parts borax. This compound is mixed with any of the suitable metallic oxides, in the necessary proportions, according to the colour required to be given.

The patentee describes, lastly, a mode of ornamenting flat surfaces of glass or other similar substance, by employing "poncis" (we presume stencil-plates); through the open parts of which he deposits the colour on the glass (previously coated with gum), and fixes it by means of steam.—*Mechanics' Magazine*, No. 1411.

NASMYTH'S OIL TEST.

In all the contrivances which have been proposed as Oil Tests, a most important element has been left out, namely, *time;* inasmuch as the evil which is experienced from the use of a bad quality of oil is only developed after the lapse of several days, when by the action

of the oil upon the metal with which it is in contact, together with the action of the air, such oils become viscid, and begin to clog instead of facilitating the movements of the parts of the machinery it was intended to lubricate.

In the more delicate descriptions of machinery, such as chronometers, watches, clocks, &c., such a defect as the thickening of the oil by lapse of time is a most serious evil; and in examining into the comparative fitness of certain oils for such applications, if we do not include *time* as an element in our examination, we shall be led to form most false conclusions, inasmuch as it is the case that for the first day or two, some kinds of oil (linseed oil, for example) perform the lubricating duty very well; but at the end of the second or third day they become so thick and viscid as to entirely arrest the motion of the machinery.

The most valuable quality in an oil intended for the lubrication of machinery is *permanent fluidity*. That oil which will for the greatest length of time remain fluid in contact with the iron or brass is, without doubt, the most useful for the purpose. Hence, as before said, the necessity of including the element of *time* in any experiment on the comparative value of such oils.

Some idea may be formed of the importance of having the means of arriving at correct conclusions on this subject, when we know that in certain spinning establishments there are upwards of 50,000 spindles in motion at the rate of 4000 or 5000 revolutions per minute! The slightest defect in the quality of the oil in such a case, by its becoming viscid, tells in the most serious way upon the quantity of fuel consumed in generating the power required to maintain at this high velocity such a multitude of moving parts. The slight increase of fluidity consequent on the rise of temperature, caused by the lighting of the gas in the rooms of a cotton-mill, makes a difference of several horses' power in the duty of the engine of an extensive establishment.

The Oil Test we have now to describe, and which is an invention of Mr. Nasmyth's, consists of a plate of iron 4 inches wide by 6 feet long, on the upper surface of which six equal-sized grooves are planed. This plate is placed in an inclining position, say 1 inch in 6 feet. The mode of using it is as follows:—Suppose we have six varieties of oil to test, and we are desirous to know which of them will for the longest time retain its fluidity when in contact with iron and exposed to the action of the air; all we have to do is to pour out *simultaneously* at the upper end of the inclined groove an equal quantity of each of the oils under examination. This is very conveniently and correctly done by means of a row of small brass tubes. The six oils then make a fair start on their race down hill; some get a head the first day, and some keep a head the second and third day, but on the fourth or fifth day the truth begins to come out; the bad oils, whatever good progress they may have made at the outset, come soon to a standstill by their gradual coagulation, while the good oil holds on its course, and at the end of eight or ten days there is no

doubt left as to which is the best; it speaks for itself, having distanced its competitors by a long way. Linseed oil, which makes capital progress *the first day*, is set fast after having travelled 18 inches, while second-class sperm beats first-class sperm by 14 inches in nine days, having traversed in that time 5 feet 8 inches down the hill. The following table will show the state of the oil race after a nine days' run :—

RESULTS OF OIL TEST.

Description of Oil.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft, in.
Best sperm....	2 $8\frac{1}{2}$	4 2	4 $5\frac{3}{4}$	4 6	4 6	4 6	4 $6\frac{1}{8}$	stat.	
Common sperm	1 7	3 9	4 $6\frac{3}{4}$	1 11	5 $1\frac{1}{2}$	5 4	5 $6\frac{3}{4}$	5 $7\frac{3}{8}$	5 8
Galipoli	0 $10\frac{1}{4}$	1 $2\frac{1}{4}$	1 6	1 $6\frac{1}{2}$	1 $7\frac{5}{8}$	1 $8\frac{2}{4}$	1 9	1 $9\frac{1}{4}$	1 $9\frac{1}{2}$
Lard..........	0 $10\frac{1}{4}$	0 $10\frac{1}{3}$	0 $10\frac{3}{4}$	1 $10\frac{3}{4}$	0 $11\frac{3}{4}$	stat.			
Rape..........	1 $2\frac{1}{4}$	1 $6\frac{1}{4}$	1 7	1 $7\frac{1}{8}$	1 $7\frac{1}{4}$	1 $7\frac{1}{4}$	1 $7\frac{1}{4}$	1 $7\frac{3}{4}$	stat.
Linseed	1 $5\frac{1}{2}$	1 6	1 $6\frac{3}{4}$	1 $6\frac{1}{4}$	1 $6\frac{1}{4}$	1 $6\frac{1}{4}$	1 $6\frac{3}{4}$	stat.	

Mechanics' Magazine, No. 1419.

ACHROMATIC MICROSCOPE.

DR. FISHER, of Liverpool, has enriched his invaluable and extensive series of philosophical apparatus by the completion of a most splendid Achromatic Microscope, which opens a new world, and displays the most wonderful scenes of creative power, wisdom, and design. This microscope has eight eye-pieces, and fifteen complete sets of magnificent object-glasses, which form three times the number that generally accompany the most costly instruments. Here are united the very highest efforts of the most distinguished scientific men of the present day, all made expressly to order, and regardless of expense. The chromatic and spherical aberrations of these glasses are perfectly balanced, and brought to an amount of perfection that could scarcely ever have been anticipated. The high magnifying powers were ground and combined by the celebrated Rosse, and the lower by Power and Leland, of London, each so much distinguished for these focal lengths. The intermediate achromatics are by the eminent Oberhauser, a well-known German; and others by Charles Chevalier, a Parisian, who, for perfection in the microscope, was lately honoured with the gold medal by the French Institute. The polariscope was made in Edinburgh, and the mechanical department from the most approved models by Abraham and Co., of Liverpool. Dr. Fisher has in his possession a great variety of living animalcula, which are truly astounding. Many of these have a high degree of transparency; and, when subjected to the penetrating glance of this powerful instrument, the circulation of the blood, the pulsation of the heart, the play of every muscular fibre, and, indeed, the whole of their unique and internal machinery, are fully and clearly developed. Even the delicate phenomena of chemistry, when carefully arranged on the stage, can be distinctly seen in action, and become an endless

and delightful source of instruction and amusement. The polarizing properties of crystals are also exceedingly beautiful. These interesting phenomena are displayed with a brilliancy and richness of colours that are almost inconceivable. This elegant instrument, which is certainly a wonderful production, cost the proprietor not less than one hundred and twenty guineas.—*Newcastle Journal.*

IMPROVEMENT IN THE REFLECTING TELESCOPE.

MR. NASMYTH has described to the British Association, his new arrangement of the Reflecting Telescope, by which great additional comfort is afforded to the observer. This consists in having the centering or trunions at the centre of gravity; through one of which, in a tubular form, the rays from the reflector within are thrown into the eye thus placed, as in the Newtonian telescope, at the side. The advantage from this arrangement is, that the eye does not require to move upon a movement of the telescope. Mr. Nasmyth then described his plan of casting specula, by which unsoundness was avoided.

SPECULUM SUPPORT.

MR. LASSELL has given to the British Association, an explicit account of his new method of supporting a large Speculum free from sensible flexure in all positions. This he proposes to do, when in a horizontal position, by supporting it at eighteen different points, on which the weight might bear equally; and by casting the speculum with ribs, he proposes to adapt levers, that when the telescope is elevated they may bear the weight among them, and thus prevent it from disturbing the true form of the speculum. Dr. Robinson said that it appeared to him that the suggestions of Mr. Lassell would remedy the annoying evils which every astronomer had to contend with.

ELLIOTT'S OPISOMETER, FOR MEASURING CURVE LINES.

THIS little simple instrument is for the purpose of measuring the length of roads, rivers, fences, walls, &c., on maps or plans drawn to a scale, without arithmetical calculation, and also for measuring curvilinear surface.

The principle of the Opisometer is, that, after having been applied to any line, it retraces or measures backwards precisely the same length on the scale accompanying the map or plan with which the line is to be compared. It consists of a milled wheel with a steel screw for its axis, mounted on a convenient handle. To measure the length of a line, as the distance between two towns, by the road traced upon a map, the milled wheel is turned up to one end of the screw until it stops; then the instrument is placed on the map, in an upright position, the wheel resting upon one extremity of the line to be measured, and is run along the road or curve following every bend as closely as possible, carefully keeping the wheel in contact with the paper, but the pressure not such as to injure the

map. When the wheel has arrived at the other extremity of the line, the instrument is lifted carefully from the paper, and carried to the commencement of the scale; the wheel is then run backwards along the scale until it stops at the same end of the screw from which the measurement began; and the division of the scale at which the wheel stops shows the length of the line measured on the map. Should the scale be shorter than the line measured, when the wheel arrives at the end, it is to be carried to the commencement again as often as may be necesssary, counting the number of repetitions.

The difficulty of measuring lines of double curvature is removed by the use of the Opisometer, while it is applicable to almost every purpose for which the flexible rule is used, and generally preferable to the string used by surveyors in measuring small circular works. In these cases a suitable scale of equal parts answers the same purpose as the scale on the map.

The accuracy of the result derived from the Opisometer is unaffected by the dimensions of the instrument itself, and depends principally on the care with which it is used; the chief point being to see that the handle of the instrument is perpendicular to the surface, at the beginning and end of each stop of the measurement. The instrument is both simple and useful.—*Expositor*, No. 5.

VARLEY'S AIR-PUMP.

Mr. Varley, Jun. has explained to the Society of Arts, his improvements in the Air-pump. In place of the two barrels and vibrating intermittent motion of the ordinary pump, Mr. Varley has a continuous circular motion in the handle, and one double-acting barrel. The piston-rod is attached to a crank on the motion-shaft, and the cylinder oscillates from its bottom; a packed joint being most ingeniously done away with by having the tube between the barrel and the receiver coiled spirally, which, by its spring, gives play enough for the oscillation of the barrel. Mr. Varley explained his larger pump, in which there are some ingenious contrivances in addition to those already mentioned. Instead of a valve opening inwards into the barrel by the pressure of the air, as in the old pumps, the valve is worked by an eccentric, and is so arranged as to open a communication between the top and bottom of the barrel at each stroke, by which the rarefaction of the air is doubled. He has obtained, with this pump, a vacuum of one-tenth of an inch of mercury.

The air-pumps exhibited were made as well as contrived by Mr. Varley himself,—a circumstance alluded to by the chairman in expressing to him his approbation of the great ingenuity shown in them, and the thanks of the Society for his explanations.

SHAW'S PATENT INDIA RUBBER AIR-GUN.

Mr. Shaw, Glossop, Derby, musical instrument-maker, has Patented Certain Improvements in Air-guns. Mr. Shaw's air-gun is constructed with the syringe or pump placed between the breech and the barrel, and fitted with an air-tight piston having a recess in

the back to receive the trigger, which is acted on behind by a spring, and thereby kept in a vertical position so as to hold the piston fast against the breech end of the pump, and keep the gun at full cock. The fore part of the piston is firmly attached to a rod, the other end of which is hooked, and passes through an air-tight orifice in the fore end of the pump. Above this orifice is a second one, which opens into the barrel destined to receive the bullet. The stock is made to extend the whole length of the barrel, and has a groove cut in it, which receives the hooked end of the piston rod. The end of the groove, near the mouth of the barrel, is fitted with a stud, to which is attached an endless band of vulcanized India-rubber, the other end of which is connected by a linen band to the hooked end of the piston rod. The bottom of the barrel is slightly contracted, to prevent the bullet being rammed into the pump. A slot is cut in the under part of the groove, and a projection is cast upon the piston-rod near the hook. To cock the gun, or bring the piston from the fore to the back end of the pump, the butt is placed against the thigh; and a piece of metal, having an indentation cut on the face and fitted with two curved handles, is introduced into the slot, so as to take hold of the rod between the projection cast thereon and the hook. The sportsman, or other person, then grasps the handles with both hands, draws the projection to the breech end of the groove, and thereby forces the piston down the pump until the trigger takes into the recess, so as to maintain it in that position. The vulcanized India-rubber band is extended six and a half times its original length. The bullet is next rammed down. When it is desired to discharge the gun, the trigger is pulled, the piston released, and the reactive force of the elastic spring allowed to act; whereby the air, contained in the pump, is suddenly compressed, so as to project the bullet from the barrel. The pump is, moreover, provided with an aperture (which may be closed when not required) for admitting air to the interior, when the bullet has been rammed down before cocking.

This invention will doubtless be gladly welcomed by the lovers of ball-shooting, as enabling them to enjoy their favourite diversion at a fractional part of its former cost. The whole apparatus is enclosed in a case, which, being stocked, has the appearance of a light and elegant fowling-piece without a lock. The invention possesses several advantages over the ordinary air-gun, one of which is its superior safety, owing to the absence of a large reservoir of highly condensed air, and to the extreme simplicity of its mechanism. With a smooth or unrifled barrel, 400 discharges per hour can be made; the bullet in that case requiring no ramming, it being drawn down the barrel by the partial vacuum caused by drawing down the piston. This new Air-gun is figured in detail in No. 422 of the *Illustrated London News.*

PAPER FOR ROOFS.

MM. Ebart, proprietors of one of the largest paper manufactories in Germany, situated at Neustadt, Elberswold, have invented an incombustible cartridge paper, which they term "stone paper,"

and which is intended especially for roofing houses. It is destined to take the place of tiles;—over which it has this twofold advantage, that it is not fragile, and is very inexpensive. By order of M. Von der Heydt, Minister of Trade and Public Works, the Royal Commission of Buildings has submitted the stone paper of MM. Ebard to numerous tests, from which it results that it is at the same time impermeable and fireproof. The commission has strongly recommended it to the peasantry as a substitute for thatch.—*Daily News.*

HALES'S ROCKETS.

In some brilliant experiments with Rockets at Shoeburyness, on May 25, there was some firing of a description seldom or over witnessed in this country; consisting of a compound rocket formed of seven rockets, each ten pounds weight, enclosed in an iron case, open at both ends. The compound rocket was placed in a triangular-shaped wooden trough, open above, and set at an elevation of 25 degrees; where seven matches being placed, they were all ignited at once, and presented a most magnificent spectacle as they ascended into the air, until the object, although so large, was lost to the sight; it then went onwards to so great a distance, that its falling could not be distinguished by the naked eye. Seven rockets, bound up in the same manner, which had been filled by Mr. Hales's hydraulic pressure, were then placed in the trough, and ignited, and their ascent was beautiful, proceeding to an apparent greater elevation than the former, until they were lost sight of in the air. When the experiments were concluded, a number of boys went over the sands in the direction to which the rockets were sent, and found one of them at a distance of between three and four miles from the spot where they were discharged.

The composition used by Mr. Hales is stronger than that used in the common service rocket; and, by the aid of hydraulic pressure, he is able to place 4lb. weight of it in the same space as 3½lb. can be put by the "monkey" used in the Royal Arsenal: this gives his rockets a greater power, and he has brought them to a considerable degree of perfection in insuring their taking a correct direction.

SAFETY IN FIRE-ARMS.

Mr. Joseph Rocke Cooper, Birmingham, gun and pistol maker, has patented an invention consisting in placing underneath the stock of the gun a bent lever, turning on a pin, one end of which is hollow, and covers what constitutes the nipple, while the other end terminates in a ring for the finger. When the piece is loaded and ready for use, the hollow end of the lever is kept over the nipple by a spring hammer pressing against the back of it; and when the discharge is to be effected, the lever is pulled round until the hollow part passes the end of the spring hammer, which will then react and strike against the cap, causing the powder to explode. To place the cap on the nipple, the barrel is partially turned round, and, after

priming, is returned to the first position. To prevent accidents, the ring end of the lever is provided with a guard, which has to be slidden out of the way, before the bent lever or trigger can be moved. The patentee describes, lastly, how this principle of construction can be modified and applied to revolving pistols or guns.

SEARS'S PATENT GUN.

THIS invention, patented by Mr. M. U. Sears, 36, Burton Crescent, London, is on the principle of a needle-gun, (*zündnadelgewehre*) and is applicable to military muskets, carbines, rifles, pistols, and fowling-pieces, or the using of a cartridge of pecular arrangement and composition. By Mr. Sears's plan, the difficulty of furnishing troops with ammunition, (so prominent an objection to the Russian military musket used by the fusileers in the Russian army,) is entirely obviated; the soldiers are enabled to carry a greater number of cartridges, and also to make them for themselves with the greatest ease and safety, and effect a saving of upwards of 25 per cent. compared with the cost when percussion-guns are used.

The loading is a very important feature in the invention, and it can be effected without the least difficulty in any position of the body, whether lying flat on the ground, on foot, on horseback, or in the rigging of a ship; for it does not require that the gun should be turned, as is the case when a ramrod is used to drive home the cartridges with the common muskets of the service, and with fowling-pieces. The cartridges used with Mr. Sears's construction of gun are very small, the great number of charges obtained, 60 out of each quarter of a pound weight of powder, being compared with the quality used in the common ball cartridges of English muskets. The "ball" is formed in the shape of a sugar-loaf, and more tapering than the balls used by Mr. Lancaster and others. Mr. Sears's ball cartridge is put into the breach of the barrel through a cavity in the under part of the stock of the gun, and requires no other exertion than the use of the thumb and forefinger of the right-hand. A sliding but strongly made groove, similar to the head of a bayonet, is then pushed forward, and renders the breach of the barrel air-tight, and not liable to be injured by any concussion. In the centre of the extreme end of the sliding groove is a needle, which is pushed sharply forward on the trigger being drawn, and is very effective in its operation.

This construction of gun appears very simple and easily used; and four rounds can be fired from it in a minute, which might be extended to five or six, by those acquainted with its operation, after a short practice. It differs materially from the Prussian military musket, and all others loading at the barrel: in the latter, the smoke of the powder escapes: but, in some experiments made in the Woolwich marshes, on Feb. 26, in no instance was there the least appearance of smoke at the breach of Mr. Sears's guns. The explosive-power of the gunpowder is so effectively employed as to leave the barrel as clean after firing 54 rounds as it was after the first

discharge: the gun, consequently, is not apt to get clogged, as is the case with common muskets.

The above experiments were made for the purpose of showing the plan, and the small quantity of powder requisite as a propulsive power, when no escape is allowed of any portion of it at the breach; but the Commander-in-Chief will not consider any invention useful for the British service that would require to alter the present bore of all the muskets. The balls at present used in the Army and Navy are 16 to the pound weight, and the balls used by Mr. Sears about 19 to the pound, whilst the bore of his muskets is smaller, to suit the conical shape of the balls.—*Abridged from the Times*, Feb. 28.

TILLEY'S PORTABLE FIRE PUMP.

As the early application of a few gallons of water at the commencement of a fire is more effective than many tons afterwards, Mr. Tilley, the well-known fire-engine maker, has introduced a Fire Pump, which has been found of great service by the London Fire Engine Establishments; many fires having been already extinguished through its instrumentality. It is particularly suited for warehouses, as well as shops and private dwellings, as it can be worked from a bucket or any other vessel containing water, the whole of which, by means of the hose and jet pipe, can be driven with force upon the fire, although it should be behind skirting, against hanging drapery, or under flooring boards. The damage done to furniture, and the great loss of water by its being thrown from buckets, is thus avoided. Another very desirable object attained by the use of this simple instrument, is that of keeping premises cool in the immediate neighbourhood of a fire, and consequently preventing the flames from spreading. As a garden engine, it will also be found to be extremely valuable, being independent of any fixed cistern.

THE PATENT IMPULSORIA.

THIS ingenious means of applying animal power to the working of railways, so as to supersede the costly locomotive engine, has been invented in Italy, and exhibited experimentally upon the South-Western Railway. It consists in introducing the animals into a kind of coach, called Impulsoria, by which they transmit their acting power to the leading wheels. This transmission is conveyed by a very simple means, rendering useful both the driving power of the animals and their own weight. The horse being thus introduced into the Impulsoria, is placed upon a perfect rectilinear, artificial ground, or platform, turning so easily, that the animal, which is yoked to the shafts, when it walks, does not itself advance; but, what amounts to the same thing, the platform itself is pushed backward. By this artificial ground platform, called by the patentee *pedivella,* is moved a tree, armed with a pulley, from which, by means of a rope, the motion is conveyed to the axle-tree of the leading-wheels. The varying proportions between the diameters of the pulleys give different degrees of speed. The horses are to be worked always at

their usual pace, whilst the new locomotive will be able to run at any requisite speed, even at sixty miles an hour, without ever altering the usual walking pace of the horses, which are inside the impulsoria, as on the floor of a room, sheltered from the weather.

The importance of introducing the horses into the carriage in order to get more speed from the surplus of the acting power, had been long thought of; and the principle has been several times attempted in England, France, and Italy, but hitherto without success.

The new machine, whose inventor is Signor Clemente Masserano, from Pignerol, Piedmont, has been brought from Italy to England and deposited at the Nine-elms terminus of the South-Western Railway. It has been made for two horses only, and they work it very well on the *pedivella*. More than thirty waggons were experimentally drawn by it up the very inclined line of the station. For working it up and down the station, a waggon is fastened to it, when it attains a speed of seven miles an hour. It is expected to gain a speed of from fifteen to twenty miles an hour; and it is calculated that an engine of two horses more will run at a speed superior to that of a steam-engine. The Impulsoria runs either way, like the steam-engine; but the driving horses do not change direction or movement. They can instantly be stopped, without stopping the machine; and the machine can likewise be stopped while the horses continue to walk on the *pedivella*, without transmitting motion to the leading wheels.

By the simple manner in which the horses exercise their moving power on the new machine, they can work easily the usual time (commonly about eight hours a day). During these eight hours, the Impulsoria can run at least over thirty miles eight times; and as four horses do not cost much more than two shillings each per day, it would be an expense of eight shillings only, instead of 6*l.* on account of coke only, the cost of which is sixpence each mile run.

Such economy is of the utmost importance to the numerous interests engaged in the railways, subject to enormous working expenses. According to the statements by Dr. Lardner, in his valuable work on "Railway Economy," the locomotive power and rolling-stock absorb always more than half, and often four-fifths of all the working expenses. But the principal advantage of the new machine will be to afford very cheap locomotion on all branch lines, thus extending the advantage of the railway to localities hitherto impracticable from the expensive moving power.

An engraving of the *Impulsoria* is given in the *Illustrated London News*, No. 432.

SELF-ACTING SAW MILL.

The *St. Louis Republican* gives an account of a Saw Mill, constructed on a new and singular principle. The inventor is Mr. Amos Jackson, of Portowatamie county, Iowa. The mill derives its power from the weight of the log to be sawed. The ways on which

the carriage travels are fixed on bearings that enter into the frame: the opposite ends are provided with large segments of a cog-wheel working into a series of cog-wheels and pinions: thus when the log is pushed forward to the saw, its weight is brought to act with great force through the segments on a shaft having several intermediate gearings to increase the speed sufficiently for driving the crank shaft. The weight of saw logs being commonly six to eight thousand pounds, we may judge of the immense propelling power thus obtained: indeed, the fear is that means will have to be used to check and regulate the velocity of the descending mass as the segment describes its arc. The tooth edge of of Mr. Jackson's saw is made thick, and diminishes to the back, thus leaving all friction out of the question, and saving setting. The price of these mills will be light compared with others, and they can be attached to wheels for travelling through the country.

SAW-MILL DRIVEN BY ARTESIAN WELLS.

At Millwood (says an American paper) Dr. Withers has a Saw-Mill which is driven by water supplied from six Artesian wells, situated on the premises, at distances from the mill varying from some 50 to 200 yards, ranging in depth from 300 to nearly 600 feet, and affording nearly 1,000 gallons per minute. The water flows from all the walls to a common reservoir; it is conveyed thence to the mill by an aqueduct under ground, and further into a box or reservoir, whence it falls on a reaction-wheel 40 feet below, and thus puts the mill in motion. After acting on this wheel, the water is conveyed to the river by means of a tunnel, cut through a limestone rock 240 feet in length, and, at the highest point, upwards of 50 feet in depth. The tunnel is 5 feet 8 inches deep, by 4 wide. As the water is nowhere visible under the mill, and empties into the river at a point not seen from the building, some 50 odd feet below the top of the bluff, the mill, when in motion, presents to the observer the appearance of self-acting machinery.

NAVIGATING BALLOONS.

M. Julien, a watchmaker, at Paris, has exhibited a Balloon, his invention, in the form of a clumsily-built sort of fish, which he sent *against* the wind, caused to perform simicircles; in a word, made it proceed in any direction the spectators thought fit to indicate. The balloon was only a model, it is true; but that it went against the wind in the open air is an undoubted fact; and the inventor stated, what seems perfectly reasonable to suppose, that it only requires its size to be increased to carry any weight. The model was constructed of gold-beater's skin, and was about four yards long. Near the head, which terminated in a point, were two little wings, which were moved by an apparatus something similar to clockwork, or that of a turning spit; and this apparatus is set going, not by steam, but by muscular power. The balloon is thus driven on, and it is guided by two rudders, one vertical, the other horizontal, which are

also moved at will by men to be stationed in the car. The apparatus altogether is simple and ingenious. The balloon is, of course, filled with gas. There was no car, but the apparatus was attached by network, and the inventor had duly provided for the reception of ballast, so as to rise or descend at will.—(Paris Correspondent of the *Literary Gazette.)* The Editor of the *Literary Gazette* adds: "This will remind our readers of Mr. Egg's (the celebrated gunmaker) experiments at Knightsbridge, about twenty years ago, which M. Julien's contrivance so closely resembles in being fish-shaped and made of gold-beater's skin. Mr. Egg built a large place near the site of what is now Wilton-street, and expended large sums on this Dagon, or Fish-worship; but in the end the design failed, and it was found impracticable to navigate the huge balloon in the air, though we believe there was every hope and encouragement afforded by the trial of small balloons in the room where the whale was being covered with the fine skin."

REGISTER HYGROMETER.

Mr. Appold has described to the British Association, a Register Hygrometer for regulating the Atmospheric Moisture of Houses. This instrument, with a variation of one quarter of a degree in the hygrometric state of the atmosphere, opens a valve capable of supplying ten quarts of water per hour, conveying it on to the surface of warm pipes covered with blotting paper, by which the water is evaporated until the atmosphere is sufficiently saturated, and the valve thereby closed. A lead pencil attached registers the distance the hygrometer travels, and thus a sheet of paper removed by a clock would show the hygrometric state of the atmosphere at any period of time.

NEW ROTARY PRINTING MACHINE.

On the 9th of March, an exhibition took place at Paris, with the new Rotary Press, which is worked by cylindrical motion, and by a stereotype obtained from several sheets of paper made in a pulp, which gives more depth than is usually obtained from plaster of Paris; and the printing is so perfect, that even maps are produced from these cylindrical stereotypes with the minutest accuracy. The invention is by a Mr. Worms, for many years a printer in Paris. It is patented in England and all over the Continent. The exhibition took place in the large factory of Mr. Coster, in Paris, in the presence of magistrates and other authorities, and amongst them, the Directors of the Society for the Encouragement of Arts and Sciences: there were also present several of the principal printers, with the proprietor and printer of *Galignani's Messenger*. All testified their satisfaction and admiration on what they saw: the stereotype cylinder was got up in exactly fifteen minutes, and the printing on both sides quite perfect; the speed was 15,000 copies per hour, which can be augmented by corresponding steam power. The rapidity is owing to the printing on endless paper, not wetted, put

on rollers; each copy being cut off with mechanical precision. The paper which was printed at this meeting was the journal *La Presse*; but the same number of copies of the largest English journal can be produced by increasing the size of the rollers. The questions put by practical printers as regards the working of the machine and possible accidents, were all fully solved satisfactorily; it was generally admitted by all parties that the machine was superior to anything in existence, and that the simplicity of the process, together with its considerable economy, must bring about a complete revolution in printing in general. Such was the expression of M. Lenormand, and Messrs. Firmin Didot, of European celebrity: as, besides the rapidity, the economy in types is very considerable; it is only used on the pulp for the forming of the stereotype, and not worked afterwards, which is the case on all machines in use at present; whereas the new machine occupies small space, is simple in its construction, and of greater production than the American machine, or the one of the *Times* journal. The cost price is considerably less than those already mentioned. The proprietors of *La Presse* have given the first order, and subsequently ordered a sufficient number for their entire establishment. With one of these machines, two adults will do the same work as fifteen men did formerly. Presses of smaller dimensions, worked by hand labour, can be supplied at moderate prices.

The Messrs. Galignani have permitted the inventor to use their name as reference; and further particulars may be learned of Mr. Hillou, 10, Bedford-street, Strand, London.—*Circular.*

ROTARY CARD PRINTING PRESS.

This Press, exhibited at the annual *conversazione* at the Institution of the Civil Engineers, is an American invention, having been first introduced in Boston about the year 1844. The machine, which is capable of printing, by hand, 2,500 cards per hour, possesses in itself the means of distributing the ink, of inking the form, and of supplying the cards to the form, within the compass of 2 ft. 6 in. by 2 ft. The table is placed vertically, and has a backward and forward motion given to it, by a camb which works on a shaft, set in motion by a train of wheels; these wheels also turn a subsidiary shaft, on which a horizontal inking cylinder is placed, the ink being distributed by means of one roller, and the form supplied therefrom by two inking rollers, which are set in a frame working vertically in a slot.

"THE TIMES" PRINTING MACHINES.

A paper has been read by Professor Cowper, to the Institution of Civil Engineers; its object was principally to describe the machinery which had been in use, at various times, for printing the *Times* newspaper, other machines being only referred to as assisting to illustrate the object.

For this purpose a brief review of the progress of printing machinery was given; from which it appeared that the first patent was obtained by Nicholson, in 1790, who then proposed placing both the types and the paper upon cylinders, and distributing and applying the ink also by means of cylinders; another plan was to place common type upon a table, which was passed under a paper cylinder. In 1813, Donkin and Bacon proposed placing the type upon a prism, and introduced "composition" rollers. In 1816, Cowper made a machine to print from curved stereotype plates: and in 1818, one to print books from ordinary type; he also introduced the system of inking now in common use. In 1814, Kœning made the first working machine, and erected two of these at the *Times* office, which produced 1,800 per hour, and continued to do so until 1827, when they were superseded by Applegath and Cowper's four-cylinder machine, producing 5,000 impressions per hour. These machines, which were stated to be still in use at the *Times* office, consisted of a table moved backwards and forwards under four iron cylinders (called the paper cylinders), about nine inches in diameter, which were covered with cloth, and round which the sheets of paper were held between tapes. The form was fixed on one part of the table, the inking rollers lying on another part, on which they distributed the ink: some of these rollers were placed in a diagonal position on the table, so that, as it moved backwards and forwards, they had a motion in the direction of their length, called the "end-motion," which, combined with the rotatory motion, caused the ink to be more effectually distributed. The ink was held in a reservoir, or trough, formed of an iron roller called the ductor, against which the edge of an iron plate rested, and by its pressure regulated the quantity of ink given out. The ink was conveyed from the ductor-roller to the table by means of an elastic roller vibrating between them. The feeding was performed by four "layers-on," who laid the sheets of paper on the feeding boards, whence they entered the machine between three pairs of tapes, by which they were conveyed round the cylinders, and thence to the spot where the "takers-off" stood, into whose hands the sheets fell as the tapes separate.

In May, 1848, the last great improvement was introduced, when Mr. Applegath erected at the *Times* office a vertical machine (described in the *Year-book of Facts*, 1849, p. 6), which was stated to produce the enormous number of 10,000 impressions per hour. This machine consisted of a vertical cylinder, about sixty-five inches in diameter, on which the type was fixed, surrounded by eight other cylinders, each about thirteen inches in diameter, covered with cloth, and round which the sheets of paper were conveyed by means of tapes; each paper cylinder being furnished with a feeding apparatus, having one boy to lay them on and another to take them off. The inking rollers were also placed in a vertical position, against the large cylinder, upon a portion of the surface of which they distributed the ink. The ink was held in a vertical reservoir, formed of a ductor-roller, against which rested two "straight edges," connected at the back, so as to prevent the ink from running out: it was conveyed from the ductor-roller by one of the inking rollers, against which it was occasionally pushed.

The type used was of the ordinary kind, and the form was placed upon a portion of the large cylinder, being fixed to it in a very plain but ingenious manner: a slab of iron was curved on its under side, so as to fit the large cylinder, whilst its upper surface was filed into facets or flat parts, corresponding in width and number to the width and number of the columns of the newspaper; between each column there was a strip of steel, with a thin edge, to print the "rule"—the body of it being wedge-shaped, so as to fill up the angular space left between the columns of type, and to press the type together sideways, or in the direction of the lines; the type was pressed together in the other direction by means of screws, and was therefore firmly held together. The surface of the type thus formed a portion of a polygon; and the regularity of the impression was obtained by pasting slips of paper on the paper cylinders.

The operation of the machine was very simple: the "layer-on" drew forward a sheet of paper on the feeding-board, until the edge was under a roller, furnished with tapes, which dropped down and drew the sheet forward and downward, into a vertical position, when other rollers and tapes carried it round the paper cylinder, when it met the type, which had been inked by

passing in contact with the inking rollers ; the sheet then continued its progress until it reached the "taker-off."

Some statistics, relative to the printing of the *Times*, were mentioned, from which it appeared, that on the 7th of May, 1850, the *Times* and *Supplement* contained 72 columns, or 17,500 lines, made up of upwards of a million pieces of type, of which matter about two-fifths were written, composed, and corrected after 7 o'clock in the evening. The Supplement was sent to press at 7 50 P.M., the first form of the paper at 4 15 A.M., and the second form at 4 45 A.M.; on this occasion, 7,000 papers were published before 6 15 A.M., 21,000 papers before 7 30 A.M., and 34,000 before 8 45 A.M., or in about four hours. The greatest number of copies ever printed in one day was 54,000, and the greatest quantity of printing in one day's publication was on the 1st of March, 1848, when the paper used weighed 7 tons, the weight usually required being 4½ tons; the surface to be printed every night, including the Supplement, was 30 acres; the weight of the fount of type in constant use was 7 tons, and 110 compositors and 25 pressmen were constantly employed. The whole of the printing at the *Times* office was actually performed by three of Applegath and Cowper's four-cylinder machines, and two of Applegath's new vertical cylinder machines.

IMPROVED AMERICAN PIANOFORTE.

THIS improvement, termed "the Patent Dolce Campana Pedal Pianoforte," is from the manufactory of Messrs. Boardman and Gray, of New York. The effects produced by the application of this Pedal, are a prolongation of the sound and the alteration of the quality of tone from the ordinary piano (to that of Sweet Bells or Harps), and which can be used *ad libitum* by the performer ; thereby producing, not only a charming variety of sound, but a most beautiful accompaniment long sought for the voice. The mechanical part of this ingenious improvement is exceedingly simple ; being merely a number of weights arranged by a lever pedal, to fall when required, upon an equal number of screws, fixed in the sounding board of the piano, and which of course, altering the vibration, effects and produces peculiar qualities and expressions of tone, unlike anything heretofore known ; and when combined with the other two pedals, produces the lightest shade of altissimo notes, alternating with the crescendo and diminuendo, and other musical accents of any kind which may be desired, in imitation of an orchestral performance. The particular qualities of this new attachment are its clearness, brilliancy and delicacy of tone, which falls upon the ear with a surpassing softness, like the chiming peals of distant bells : hence its peculiar name, "Dulce Campana." (Sweet Bells.) This attachment is perfectly simple, and so constructed that it can be detached from the instrument in a few moments.

The Pianofortes of Messrs. Boardman and Gray, with this Attachment, have received the first premium at five several Fairs, viz., State Fairs at Buffalo and Syracuse, New York ; Pittsfield, Mass. ; Institute at Baltimore, and American Institute, New York City. It has also been employed by Mademoiselle Jenny Lind.

CHARACTERISTICS OF A BANK OF ENGLAND NOTE.

THE Rev. J. Barlow has illustrated to the Royal Institution, the

characteristics of a Bank of England note, and as far as time and circumstances permitted, the details of its manufacture. For this latter purpose, workmen and machinery were supplied from the Bank.

The Bank of England note is simple in character, having altered very little in appearance since it was first issued at the end of the seventeenth century, but the quality of the paper and of the engraved writing have now been brought up to a high degree of excellence. In thus perfecting their note, the authorities of the Bank have had entirely in view the protection of the public from fraud and loss. Instead of defending themselves, as is the practice in some other countries, by secret marks on their paper money, the substance and printing of which are equally ill executed, the Bank of England accepts no security which may not be possessed by any one who will make himself acquainted with the following characteristics of the paper, the plate printing, and the type printing of the note. The paper is distinguished:—1. By its *colour*, a peculiar white, such as is neither sold in the shops, nor used for any other purpose.—2. By its *thinness and transparency*, qualities which prevent any of the printed part of the note being washed out by turpentine or removed by the knife, unless a hole is made in the place thus practised on.—3. *By its characteristic feel.* There is a peculiar crispness and toughness in Bank of England paper, which enables those who are accustomed to handle it to distinguish instantaneously, by the sense of touch alone, true from false notes.—4. *Wire mark.* The wire mark (or water mark) is produced in the paper when in the state of pulp; consequently, a forger must procure a mould and make his own paper. But both the workmanship of the mould and the manufacture of the paper from its intricate surface require the skill of first-rate artizans. As these are not found in the haunts of crime, a spurious imitation of the water-mark has to be affixed by means of a metallic stamp upon the counterfeit paper *after it has been made.* A false mark of this kind was produced during the discourse, and its easy distinguishableness from the true one exhibited.—5. The three *deckle edges* of the Bank note. The mould contains two notes, placed lengthways; these are separated by the knife in a future stage of the manufacture. The deckle (or wooden frame of the paper-mould) produces that peculiar effect which is seen on the edges of uncut paper. As it is caused when this substance is in the state of pulp, it is as unlike any imitation attempted upon paper as the rent or hemmed edge of linen, &c. differs from the selvage. It will be evident from this that any paper purchased for purposes of forgery, inasmuch as it has to be cut into shape, can have but *two* natural (or deckle) edges at most, instead of *three*, and must bear, in consequence, a recognizable proof of falsity.—6. *The strength of the Bank note paper.* Being made, not from the worn fibres of old garments, but from *new* linen and *new* cotton pieces, the paper of the Bank note is extremely strong. Mr. Portal, the manufacturer, supplied a simply constructed machine for testing this. It was seen by trial that in its water-leaf (or unsized) condition, a Bank note will support 36lb., and that when one grain of size has been diffused through it, it will then lift half a hundred-weight.

The processes of the printing the Bank note were then adverted to. The bulk of the note is printed from a steel plate, the identity of which is secured by the process of transferring. The paper is moistened for printing by water driven through its pores under the pressure of the atmosphere admitted into the exhausted receiver of an air-pump. This process was invented by the late Mr. Oldham about twenty-five years ago, who, at the same time, suggested its application to pickling meat. Mr. Payne's more recent patent for preserving timber is derived from the same principle. In the Bank of England 30,000 double notes are thus moistened in the space of an hour. The ink used in plate-printing is made at the Bank from linseed oil and the charred husks and vines of Rhenish grapes. This Frankfort black (as it is called) affords a characteristic velvety black very distinguishable in the left-hand corner of the note. Inks in forgeries have usually a bluish or brownish hue. The D cam invented by Mr. Oldham, perfects every impression when once drawn through the press. Several impressions were taken during the discourse from one of the Bank plates. The numbering and cipher printing

are also executed in one of the presses in use at the Bank; and a large model was dissected to show with what certainty carriage to tens, hundreds, &c. was effected by means of an extra stud on the spur of the tenth wheel. The combination of plate with type printing is itself a great security against a successful forgery of a Bank note. All that now remains is the signature of the clerk. This is chiefly valuable as a moral restraint against counterfeits. At the same time the nicety of adjustment in Bank paper manufacture is evinced by its being suited both to the printer, who requires the least, and to the penman who requires the greatest quantity of size in the paper to fit it for their respective purposes.

The process of splitting a Bank note was explained, and a large sheet of paper was split, having previously been pasted between two pieces of calico. The attraction of the calico to the paper being greater than that of the surfaces to each other, they separate under an equable pull in opposite directions. This practice never could be used for any fraudulent purpose in Bank notes, because the printed surface is that which receives the water-mark; consequently the other unprinted surface could not retain more than the faintest trace of it. In conclusion, the great diminution of forgeries since the abolition of capital punishment for that crime was noticed; and a hope was expressed that the abatement of an offence which education was once supposed to promote might be attributed to the diffusion of useful instruction combined, as it generally is, with moral and religious influences.—*Athenæum*, No. 1165.

MACHINE FOR THE SHIPMENT OF COAL.

The Committee of the Glamorganshire Canal Company have awarded the prize of 100 guineas for the best machine for transferring Coal from barges into the holds of vessels. There being 134 competitors, a great number of models were exhibited at the Cardiff Arms Inn, Cardiff; when the committee decided that the prize should be divided between Mr. G. W. Armstrong, of Newcastle-upon-Tyne, and Mr. W. D. Burlinson, of Sunderland. The machine designed by Mr. Armstrong consists of a crane, worked by hydraulic pressure. The cylinder and piston for raising the coals are placed underground, and a separate cylinder produces the circular motion of the jib. The movements are stated to be effected with great delicacy and precision by means of operating on two valves. The water pressure is obtained from a small pump, which, forcing the water into the cylinder, having a loaded plunger, in its constant endeavour to descend, keeps up a uniform pressure on the machine. Mr. Burlinson's machine consists of a lever, about 33 feet long, fixed on a shaft two-thirds from its upper end, on which a leading pulley revolves. A steam engine of 20-horse power works two of these levers. When the coal box is raised, by the ropes being wound over rollers to the end of the lever, its weight causes it to descend to the deck of the ship; and when the coal is discharged, a counterbalance at the lower end of the lever brings it back to its former position.—*Architect*, No. 74.

THE EUSTON PAVEMENT.

Mr. W. Taylor, in a paper communicated to the Institution of Civil Engineers, states that he tried a paving experiment about ten years ago, by covering a surface subject to very heavy traffic,—and subsequently, about five years since, entirely paving the Departure side of the Euston Station of the London and North-Western Railway in a peculiar manner. The system was on entirely

new principles. The method employed was, after removing the subsoil to the depth of 16 inches, to lay a thickness of 4 inches of strong gravel, equally and well rammed, then another layer of gravel mixed with a small quantity of chalk, or hoggin, for the purpose of giving elasticity, the ramming being continued as before; a third coat, of the same materials, was then laid and rammed, a regular degree of convexity of surface being preserved. The stones used were Mount Sorrel granite, dressed and squared into regular masses of 4 inches deep, 3 inches thick, and 4 inches long: these stones were laid in a bed of fine sand 1 inch in thickness, equally spread over the surface of the sub-stratum, and they were carefully placed, so that no stone should rock in its bed. The whole surface was then well driven down with wooden rammers, weighing 55 pounds each. The small size of the stones enabled them to be well rammed home, so that the surface of the pavement never sank, and the hardness and toughness of the material prevented the stones from being worn down by any traffic, however heavy. It was stated that this system was found infinitely preferable to the employment of large stones, and the statement of cost was vastly in its favour; the price of the ordinary kind of granite paving, in London, being 18s. per superficial yard, and the maximum cost of the new or "Euston" pavement, including the sub-stratum, was not 12s. per yard, and, deducting the value of the old stones, not (in this latter case) claimed by the contractor, the nett cost would only be 9s. per yard.—*Athenæum*, No. 1166.

DRY-ROT IN BUILDINGS.

A COMMUNICATION was made at a late meeting of the Linnæan Society respecting a peculiar form of Dry-rot which spread with extreme rapidity in the church of King's Wear, Devonshire, by means of long, byssoid, rope-like shoots, different in the mode of their development, except on a very small scale, from anything which had before come within our notice. A still more curious case, which we are inclined to refer to dry-rot, has lately been sent to us for inspection, reminding us of the mural leprosy of Judæa, attacking, as it does, and more or less destroying, not merely the timber, but the solid walls themselves. It occurred in an old house near Erith, on the banks of the Thames, where it has penetrated into every crevice in and between the walls and wood-work, separating the bricks and mortar, and rendering the whole so friable that the walls must be rebuilt, to prevent their falling down. The mycelium here forms a widely-expanded network of threads, which are twisted together in every possible way, so as to form anastomosing strings, of considerable tenacity, as thick as small pack-thread. A strong solution of corrosive sublimate is an effectual cure for such affections, where it is possible to apply it; but where, as in the present instance, the plague infects the whole substance of the structure, destruction seems to be the only remedy. The circumstance of the mycelium penetrating into the mortar and brickwork to such an

extent appears to be new: at least we do not recollect to have heard anything of the kind before.—*Gardeners' Chronicle.*

GIGANTIC CHIMNEY AT BOSTON, U. S.

THE New England Glass Company, at East Cambridge, have lately had erected a chimney 230 feet high, and tapering from 25 to 13 feet diameter. We learn from an American paper that it is octagonal in form, and built of brick on a granite base 36 feet in diameter. There is a chimney within a chimney, closing at the top, forming a central flue of 7 feet diameter. Three horizontal flues from the furnaces are carried in beneath to the perpendicular one; though so constructed that additional flues, if necessary, may be added. Thus, through the one cone, all the smoke from the several furnaces will be carried, and a group of smaller ones will, therefore, be demolished. 800,000 bricks, and 100 cubic yards of granite, were required in the erection.

MODEL STEAM-ENGINE CHIMNEY.

AN American writer (H. F. Fairbain) pronounces the chimney of the West Middlesex Water-Works Company, at Turnham Green, to be the finest ever erected in England. (Mr. Tierney Clark, we believe, is the designer). "It is," he says, "more beautiful as a column than the monument of London. It is crowned by a Corinthian cap, in fine proportion with every other part of this noble specimen of a steam-engine chimney, which is only deficient in the inferior colour of the bricks of which it is built, and in its position, which is neither on elevated ground nor in a part of the country where its beauties can be very fully displayed. The proportions of this chimney are considered to be complete." Length of shaft eight times the diameter of the base; diameter of the top, one-half that of the base.—*Mechanics' Magazine*, No. 1415.

REMOVING A CHURCH AT LIVERPOOL.

IN consequence of the enlargement of the London and North-Western Railway Company's station, the Church for the Blind, formerly situated in Lord Nelson-street, Liverpool, has been removed carefully, piece by piece, from its previous "location," and rebuilt, exactly in its former style and size, by Messrs. S. and J. Holme. Each piece of stone was carefully marked previous to removal.

TEBAY'S PLANNING RULE.

MR. TEBAY'S scales, sold under this title, have the great advantage over those generally in use, that the number of scales required are all contained on one simple strip of wood, arranged so that each scale of divisions reads *to the edge of the rule;* so that the required distances may be "set off" with a pencil, and the use of the compasses dispensed with. All the scales are arranged according to equal subdivision: thus, 8 on the $\frac{1}{8}$th scale is equal to 4 on the $\frac{1}{4}$th, 2 on the $\frac{1}{2}$, and 1 on the 1-in. scales. The 10ths and 12ths, subdi-

visions, are at opposite ends of the rule, so that all the scales of each class may be read off the edge, from the smallest scale to the largest, by merely reversing the rule sideways, which is easily done in the left hand, being that in which the rule is held when used. These scales must be cheapened, and will then doubtless come into use.—*Builder*, No. 372.

CLIFF BLOWN UP AT SEAFORD.

On September 19, a grand explosion of 27,000lb. of gunpowder by the voltaic spark took place at Seaford, the object being to arrest the encroachment of the sea, and prevent the beach from drifting. The works were executed and prepared by the Sappers and Miners. The cliff was penetrated from above by five shafts 41 feet each in depth, for a charge of 600lbs. of gunpowder; and a gallery, 6 feet high and 5 feet wide, penetrated below from the face of the cliff to a length of 80 feet into its interior, with two smaller branch galleries 3 feet in height, each terminating in a chamber 6 feet 6 in. square in cubic measure, and containing 12,000lbs. of powder. Sir John Burgoyne had the management of the works, which were personally superintended by Captain Froome. The voltaic batteries were under the charge of Mr. Ward.

The operation was completely successful. The galleries and chambers filled with gunpowder were fired by the voltaic battery placed behind the cliff; when, in presence of a vast number of spectators, an immense mass of cliff, at least 100 feet in height, twice as broad, and running out to a point about 300 feet, bent forwards towards the sea, cracked in all directions, crumbled into pieces, and fell upon the beach in front of it, forming a bank down which large portions of the falling mass glided slowly into the sea for several yards, like a stream of lava flowing into the water. As in previous instances, there was no very loud report, though a rumbling noise was heard, and a tremulous vibration was felt nearly three miles off. A chimney fell at the village, three quarters of a mile off. The mass separated was larger than expected, and is thought to have comprised at least 300,000 tons. The effect of the first discharge was so great, and the ground was so loosened near the telegraph-house, that the upper charges were not fired. The beach is about 200 feet wide at low water, as was the case at the time of the explosion, and that space was more than covered. The explosion at Dover was performed with a smaller quantity of gunpowder, but the work done was greater there, as there was a natural cleft behind. It is to be presumed that some future means of fixing the sea-wall thus formed, so as to prevent its being washed away in course of years, will be taken; otherwise throwing the cliff into the sea might only tend to accelerate the mischief by bringing the material prematurely within the destructive influence of the waves.—*Builder*, No. 399.

EXPLOSIONS IN COAL MINES.

A paper has been read to the Institution of Civil Engineers, en-

titled "A comparative View of the recorded Explosions in Coal Mines," by Mr. William West. The reports of Faraday, Lyell, De la Beche, Playfair, and others, were analyzed and tabulated, from which it appeared, that tendencies towards a dangerous condition existed in mines reputed to be comparatively safe; and that these tendencies were so numerous, and varied so suddenly in their nature and extent, as to necessitate attention to every kind of precaution.

The compatibility of general good ventilation with the occasional occurrence of the most fatal explosions was particularly dwelt on. The witnesses on the inquests after the Haswell and the Jarrow accidents agreed that the "ventilation was perfect," "the pit full of air," and "the air quite good, and plenty of it." The fault, then, did not lie in the quantity of air, but rather in the difficulty of directing it so generally throughout all parts of the mine as to sweep away the gas as it was produced. The "splits" for the air were noticed, and the condition of the goaf, the pockets of gas formed in the roof, and the sudden irruptions from the occasional falls in the goaf and old stalls, were dwelt on at great length; and, combined with the injudicious use of unprotected lights, and the liability of accident to the lamps, were shown to have been the probable cause of all the explosions.

The precautions for saving life on the occurrence of accidents, such as abolishing bratticed shafts, and sinking a pair at each mine, at such distances apart as should insure one remaining intact, in case of an explosion injuring the other; the "scaling off" of a portion of the fresh air for the exhausting furnace, and conducting the return air into the upcast shaft at some height above the fire; together with several minor details for insuring the constant working of the exhausting apparatus to draw off the fatal "after-damp, or choke-damp;" were strongly insisted on.

VENTILATION OF COLLIERIES.

On Nov. 11, a paper was read to the Institution of Civil Engineers, entitled "The Ventilation of Collieries theoretically and practically considered," by Mr. W. P. Struvé.

The author commenced by showing that the general principles which ought to govern the ventilation of collieries were—

1st. That a current of air through the channels of collieries, at a velocity of five feet per second, was sufficient for most purposes.

2nd. That a current exceeding that velocity would only be attained at the expense of leakage and other evils.

3rd. That in order to obtain the requisite supply of fresh air, the channels of a colliery or mine ought to be enlarged, according to the exigency.

In the process of laying out a mine, a subdivision occurred by which the workings were apportioned into numerous compartments, which facilitated the system of splitting the current of air, or diverting it into numerous channels, giving to each compartment a separate and, therefore, more effective ventilating force: at the same time

the area of the channel was enlarged, and the aggregate length of the air tube shortened, so that it was quite impracticable to pass through the workings of a mine 300 cubic feet of air per minute for each man employed.

The details of two experiments at the Eaglesbush and Ynis David Collieries, where the air was pumped out by Mr. Struvé's Mine Ventilator, showed that a large proportion of the air was drawn from the old workings and the "goaf" or broken ground surrounding the colliery, and did not come down the in-take shaft, and traverse the actual workings, as it ought to have done.

In both these cases, the enlarging and splitting of the air-channels, so as to reduce the velocity of the air to about three feet or four feet per second, would have produced most beneficial results.

These principles were shown to have been lost sight of in the majority even of the great collieries, and the power of rarefaction by a furnace was trusted to for dragging the long column of air over and through innumerable impediments.

The experiments of Mr. Nicholas Wood, Mr. G. Elliot, Mr. H. Vivian, and other mining engineers, were quoted, to demonstrate the insufficiency of the "steam jet," as a means of promoting ventilation; showing that it was a wasteful application of power, when compared with the steam force employed to work the lecturer's own Mine Ventilator at the Eaglesbush Colliery.

At the meetings on Nov. 26 and Dec. 3, the discussion on Mr. Struvé's paper was continued, to the exclusion of every other subject. The difficulties found in using mechanical exhausters were attributed in a great degree to the small size of the inlet and outlet valves; the improvements introduced by Dr. Arnott in the apparatus for ventilating the New County Hospital, at York, were instanced as examples of the necessity for using curtain valves, of large area, for the machines, as it had been found that as the dimensions of the valves were increased, the power required to work the machines diminished. The application of small water-power engines, like those made by Mr. Armstrong (of Newcastle) for giving motion to the ventilating machines, was recommended as very effective and most economical.

On Dec. the 10th, the discussion on Mr. Struvé's paper was continued throughout the evening. The steam jet, in its application to the upcast shaft, was again considered: it was argued, that, like the furnace, it did not produce any pulsation in the current of air which was so very wasteful of the power for giving motion to all means of mechanical ventilation; and, therefore, that by the accepted laws of physics, the steam jet setting in motion a body of air which continued to flow without intermission through the galleries and the upcast shaft, subject only to the deduction for the pressure of the atmosphere, and the friction of the column of air on the surface over which it passed, was prejudicial.

In summing up the discussion, the Evidence given before the House of Lords, in 1849, was again minutely analysed, with the

view of snowing that the deductions previously drawn were not correct, inasmuch as the results obtained were owing to temperature, and not to the exhaustion created by the steam jet. The published opinion of M. Combes,—"that the useful effect of the steam employed to produce the motion of the air, by projecting it into a tube, is in all cases much below what it is capable of producing when applied to a steam-engine working mechanical ventilators of the most imperfect description," was quoted in support of these views.

EDWARDS'S ATMOPYRE.

According to Dr. Arnott, England, of all countries, is the most extravagant in the use of fuel. The comparative cheapness of coal in Britain is the cause of this carelessness. The inconveniences, however, occurring, in large towns, especially where manufactories are numerous, from the diffusion, in the shape of smoke, of the unconsumed particles of the fuel, and the consequent deterioration of health, have prompted the invention of many methods for the prevention and destruction of smoke. One of the most novel of these inventions is suggested by Mr. D. O. Edwards; it is named the "Atmopyre," or solid gas fire. A small cylinder of pipe clay, varying in length from 2 to 4 inches, perforated with holes the fiftieth of an inch in diameter, in imitation of Davy's Safety Lamp, is employed. The cylinder has a circular hole at one end, which fits upon a "fishtail" burner; gas is introduced into the interior of the cylinder, with the air of which it becomes mixed, forming a kind of artificial firedamp. This mixture is ignited on the outside of the vessel, and burns entirely on the exterior of the earthenware, which is enveloped in a coat of pale blue flame. The clay cylinder, which Mr. Edwards calls a "hood," soon becomes red hot, and presents the appearance of a solid red flame. All the heat of combustion is thus accumulated on the clay, and is thence radiated. One of these cylinders is heated to dull redness in a minute or two; but an aggregate of these "hoods" placed in a circle or cluster, and enclosed in an argillaceous case, is heated to an orange-colour, and the case itself becomes bright red. By surrounding this "solid gas fire" with a series of cases, one within another, Mr. Edwards has obtained a great intensity of heat, and succeeded in melting gold, silver, copper, and even iron. Mr. Palmer, the engineer of the Western Gas-light Company, by burning 2 feet of gas in an Atmopyre of twelve "hoods," raised the temperature of a room measuring 8,551 cubic feet, 5° of Fahrenheit in seventeen minutes. The heat generated by burning gas in this way is 100 per cent. greater than that engendered by the ordinary gas flame when tested by the evaporation of water. 25 feet of gas burnt in an Atmopyre per hour, produce steam sufficient for a 1-horse power. Hence the applicability of the invention to baths, brewing, &c. The inventor's attention has been chiefly directed to the warming of invalids' apartments; and for this purpose he employs the following apparatus:—A battery of twelve "hoods" is enclosed in an earthenware case, which, becoming heated to 500s.

Fahrenheit, forms a repository of heat. This is placed in an outer case of china, terra cotta, or any other ornamental ware. The products of combustion are carried away by a small pipe into the chimney. It would be better to let this pipe remain in *alto-relievo* in the apartment. The fresh air is brought from outside the dwelling through a tube about 6 in. in diameter, which communicates, by means of a valvular iron plate, with the space between the two cases. The air ascends in this area in large quantities, is warmed in its transient contact with the inner case, enters the room through large holes in the top of the stone, at a blood-temperature, and spreads equally through the apartment. This fire presents a cheerful aspect through the wide orifice of the stone, which is covered with glass, and is visible to every inmate. The expense of such a fire is sixpence a day, at the present price of gas: and its application to cooking, evaporating liquids, desiccating aromatic plants, &c., is decidedly economical. Hydrogen burnt in the "Atmopyre" produces great heat, and a very bright fire.—*Lancet.*

VENTILATION OF HOSPITALS AND OTHER BUILDINGS.

The conditions prescribed for Dr. Arnott with respect to the Ventilation of the York County Hospital, now in progress, were the forcing of a sufficient quantity of air into the building every minute, and the means of measuring that quantity exactly: 2000 cubic feet a minute was the amount determined on, and it was desired that the apparatus should be as nearly self-acting as possible.

To meet these requirements, a pump has been constructed, consisting of a weigh-beam, with a gasometer (a bell-shaped metal vessel) working in a trough of water at one end, and a counterpoise at the other. The gasometer is about 6 feet diameter, and holds 125 cubic feet of air. Every time the gasometer descends or ascends, its contents are discharged into air-drains leading to the building; and this being made to occur sixteen times in a minute, the requisite 2000 feet of air are delivered.

To give motion to the machine, the well-known property in fluids of transmitting pressure equally in all directions was had recourse to. An inch pipe from a cistern of water 60 feet above the apparatus gives a pressure of 30 lbs. on the square inch, and this, acting on a syringe 12 inches long, with a piston 2 inches in diameter, is sufficient to force up the gasometer, which, being heavier than the counterpoise, again descends by its own weight: of course, if the column of water were 120 feet long, half the quantity of water would do the same work. By the arrangement we are describing, the quantity of water used per day is 1440 gallons, which at the Manchester rate would cost 4½d. per day, if wasted; but, inasmuch as it is uninjured and unsoiled, it may be used for domestic purposes, and so would cost nothing. To prevent the pipes from being burst by the shutting off of the column of water, an air-vessel is provided near the syringe; by which, and other ingenious arrangments, the general idea we have indicated is carried out.—*Builder*, No. 403.

VENTILATION OF WORKHOUSES.

SIR JOHN WALSHAM has devised a very simple plan for Ventilating Workhouses, which has proved effectual in the several Unions where it has been introduced; and would, no doubt, be equally available for hospitals, factories, or workhouses. It consists of zinc tubes, three inches in diameter, perforated at the sides, towards the bottom, with holes of $\frac{1}{12}$th of an inch diameter; these are carried across the ceiling of the room, suspended by hooks, and taken through the walls to the open air, where they terminate in perforated convex ends, provided with caps, hung by a small chain, to cover the end most exposed to the wind in extremely cold weather. Three tubes will suffice for a room 23 feet by 16, or in that proportion for larger apartments, intervals of about 10 feet in the length of the room being ordinarily the just medium. They can be fixed at 5d. per foot run. Mr. Bridgham, master of the Loddon Union-house, describes them as most beneficial there, particularly in the sleeping-rooms. "The inmates are very pleased with them: many were fearful they would take cold from them; but they are now satisfied that there is not any draft occasioned in the room by them." In the Bishop Stortford Union, "in a sick ward, with cases of a loathsome and offensive kind, tainting the air to such an almost incredible extent that few gentlemen of the Committee would go into it, the effect was so good that the guardians gave an order to ventilate the whole house."

ROWAN AND SONS' METHOD OF VENTILATING FACTORIES.

AN entirely new system of Ventilation has been discovered by these eminent practical engineers, and has been successfully adopted in their new establishment at Belfast. The whole application of the system is partly confined to the rows of hollow columns which support the floors of the building. A sufficient opening is made near the upper part of the column to admit a ventilator, which is placed in a position to receive a portion of the fresh air constantly supplied by the outer door of the building. The columns are placed directly one above the other (as is the case in other mills), so as to form a complete funnel, carrying off all foul evaporations at top of the mill; while the columns are so constructed that, on the upper extremity of each, a trumpet-shaped conveyancer attached completes the apparatus, and will, when carried out, perform the most perfect ventilation beyond the possibility of failure. In addition to the above are ventilators placed at the top of each window, inside, acting independently of the central columns, on a new principle, which conducts the evaporarion at once from the room in which it is placed, by a funnel being built in the wall, whence it is discharged beneath the window-sill of the next story. In this ventilator, which extends across the whole breadth of window, is a moveable valve, which is worked like the throttle-valve of a steam engine, and can be set at pleasure by a cord being attached to it.—*The Northern Whig.*

SHERINGHAM'S VENTILATING VALVE.

Mr. Sheringham, the inventor of this new means for supplying rooms with fresh air, states that Dr. Arnott's Ventilating Valve,* and the others upon that principle, are beneficial when a fire is used in the lower part of the chimney flue in which those valves are introduced, and where there is consequently a strong upward current of air rarefied by the heat from below; but where there is a down draught by that flue, as in the case, for example, of what is called a "smoky chimney," they are, during the continuance of the downward draught, entirely inoperative; and it is apprehended that Dr. Chowne's† plan is not *free* from the same objection. All these plans, therefore, are inoperative when a ventilator is much wanted. Dr. Arnott's valves and Dr. Chowne's syphon are not constructed for the admission of *external* air; but their proposed action contemplates the requisite supply of unvitiated air for the support of life, and other combustion, by drafts through the fortuitous cracks and crevices afforded by the imperfect fittings of our dwelling-rooms, or otherwise by open doors or windows. It is the design of Mr. Sheringham's invention, that all the advantages of due ventilation shall be afforded without the agency of any such objectionable or adventitious drafts.

Arrangements such as are sometimes introduced in the windows of churches, resemble in some respects, it is conceded, the plan contrived by Mr. Sheringham; but they fail to satisfy the requirements of position, direction, cheapness, and susceptibility of general adaptation, without discomfort or defacement of internal decoration.

The Ventilator contrived by Mr. Sheringham is as follows:—A flap, with quadrant ends at right angles to it, is constructed to fit into a frame in the form of a parallelogram: to each lower corner of the flap is a pin, which pins work in corresponding sockets at the lower corners of the opening of the frame. The flap, by mechanical arrangements, is susceptible of being thrown outward to an angle of about sixty degrees, or pulled up to any less angle, or the opening may be entirely closed by the flap, when it is desired to do so: one line for the regulation of all the above operations is brought within reach of the hand.

The flap proposed for a room about ten feet square is about nine inches long, by about three inches deep, working in a suitable frame.

A perforation is to be made in an external wall, fully as large as the ventilator, the upper part of which should be from four to eight inches below the ceiling of the apartment to be ventilated. Mr. Sheringham's ventilator may then be fixed in the opening from within, so that the flap of the ventilator, when pulled into the frame, may be on the same plane as the inner surface of the wall. The whole face of the ventilator may be papered or painted in the same manner as the piece of wall which is removed for its introduction, but so that the flap may fall freely within the room whenever an inlet of air is desired. If the dimensions or nature of the interior

* Described in the *Year-book of Facts*, 1850, p. 66.

† Described in the *Year-book of Facts*, 1850, p. 68.

to be ventilated require a larger opening than can be externally closed by an air-brick; or if the position of the building to be ventilated appears to demand an especial provision against the entrance of soot or other natant substance in the atmosphere, an iron frame, covered with perforated zinc, or gauze wire of adequate fineness, may be substituted for the air-brick.

It will be found that the oblique direction which is given to the flap of the ventilator, when opened, will induce an upward direction to the in-coming current of air admitted by it; and that this upward direction will be retained a sufficient length of time to enable it to become warmed, and dispersed through the warmer air within the apartment before it reaches the occupants: hence there will be removed from such in-coming current of air, in sufficient time, all the injurious tendencies of a cold current of air frequently, and *frequently severely*, felt from an open window.

Mr. Sheringham's ventilator may be left open in temperate weather, day and night, in reception-rooms, dormitories, and other internal structures, not only with perfect impunity, but with great comfort and advantage to health. We can, from experience, recommend this improvement.

Mr. Sheringham's ventilator, which is registered, is manufactured only by Messrs. Hayward, 196, Blackfriars Road.—*Illustrated London News*, No. 422.

A LARGE FLUE.

In course of operations in the Tamar Silver Lead Mines, on the borders of Devon and Cornwall, it became latterly essential either to erect a powerful steam-engine at the foot of a subterranean inclined plane, 2000 feet in length, and running right below the river which flows over the mine, to a perpendicular depth of 800 feet below its bed; or, failing that, to shut up the mine and throw 1500 people out of employment. It was therefore determined to adopt the former alternative, and a 20-horse steam-engine, one of the patent combined hydraulic engines from Walker's manufactory, at Oliver's Yard, City Road, was accordingly fitted up at that depth. Flues were, of course, requisite; when it was found advisable to conduct these across to the furthest bank of the river, and in a series of horizontal levels united by perpendicular shafts, so that the flue in sections rises like a flight of stairs to the surface. This flue is no less than two miles long and upwards,—probably the longest flue in the world. The result was quite successful, as will appear from the following statement:—"We drew through Spurgin's shaft in October month 2988 kibbles of stuff with Walker's new underground engine: this machine is well constructed, and I have every reason to believe she will pump the shaft 150 fathoms deeper than it is at the present time. We have in these mines six steam-engines at work at the surface, but the draught of the underground engine exceeds the whole. The consumption of coals is 5 cwt. in the twenty-four hours."

DR. FARADAY ON CHIMNEYS.

At the Royal Institution, in a series of lectures on chemistry applied to domestic purposes, Dr. Faraday has thus philosophized on "a Chimney." Various illustrations were given to show the importance of the functions of the chimney. A parlour fire will consume in twelve hours 40 lbs. of coal, the combustion rendering 42,000 gallons of air unfit to support life. Not only is that large amount of deleterious product carried away and rendered innoxious by the chimney, but five times that quantity of air is also carried up by the draught, and ventilation thus effectually maintained. The force of a draught was illustrated by a descending flue. A coloured flame was held near the end of a tube bent like an inverted syphon. As soon as the tube was heated, the ascent of the air within the longer arm of the tube drew the flame downwards into the shorter arm with considerable force. Since the ascent of smoke up a chimney depends on the comparative lightness of the column of air within to that of an equal column without, the longer the chimney the stronger will be the draught, if the fire be sufficiently great to heat the air; but if the chimney be so long that the air is cooled as it approaches the top, the draught is diminished. A case of this kind occurred at a lighthouse on the Isle of Portland. The chimney which ventilated the building and the lantern was carried on the outside, and in winter time the draught was so much impaired that the windows became dim and the lights obscure. An attempt had previously been made to remedy the defect by lengthening the chimney; but that, of course, had made it smoke all the more. The application of a jet of steam to increase the blast of locomotive engine furnaces was illustrated. The lower end of a bent glass tube was placed in a dish which contained coloured liquid, the upper end being inverted into a larger and horizontal tube. A jet of high-pressure steam directed through the larger tube caused such a rush of air to supply the place of the air expelled by the steam, that the coloured liquid rose to the top of the tube. The mechanical force of a jet of high-pressure steam was shown by causing it to sustain an egg, which was seen dancing about in the air without anything apparent to support it.

COOLING AIR IN HOT CLIMATES.

Prof. Smith has described to the British Association a mode of Cooling the Air in Tropical climates. This is, in the first instance, to condense air by mechanical means; then to allow the air thus condensed, and consequently heated, to fall to the common temperature. The condensed air thus let loose, and allowed to fall into a room, would, by its expansion, lower all the air with which it comes in contact. Professor Smith has tested the principle on a large scale, and found it to answer his expectations.

Mr. Taylor knew of men working in one of the Cornwall mines at a temperature of 110°. It would now be possible to send them down a treat of cold air, which he had no doubt they would relish as much as a lady does an ice on a hot day. Mr. Rankine said, in

reference to the power required, that he had made the calculation, and the result was, that one horse working for one hour lowers 9,000 cubic feet of air 20°; and, of course, in this proportion for all other cases. This was exclusive of friction.—*Athenæum*, No. 1176.

PURIFICATION OF COAL-GAS.

MR. LAMING has described to the Society of Arts, his process, which has been hitherto successfully put into action at Paris; at the Chartered Company's Westminster Works, on a small scale; and at the Imperial Company's Haggerstone Works, on a larger scale. The process consists of two parts:—1. The removal of the impurities from the Gas; 2. The revivification of the used materials, which is made again capable of service. The purifying material is a saturated solution of muriate of iron decomposed by lime into muriate of lime, and hydrated protoxide of iron mixed with breeze; during the mixing, the iron becoming peroxide (carbonate) from the oxygen of the air. On passing the gas through this material in the ordinary purifiers, the following changes take place: The sulphuretted hydrogen combines with the peroxide, forming water and sesqui-sulphuret of iron; the ammonia and carbonic acid join to form proto-carbonate of ammonia, which again acts on the muriate of lime to form muriate of ammonia and carbonate of lime. This proceeds until none of the peroxide of iron and muriate of lime are unchanged. The purifier is then thrown out of connexion, and a current of air passed through the used material, by which it is revivified in manner following: The sesqui-sulphuret of iron becomes, from the oxygen of the air, sesqui-sulphate of iron; after which this salt and the carbonate of lime decompose each other, becoming sulphate of lime and carbonate of protoxide of iron; the latter speedily changing into hydrated peroxide of iron, while the carbonic acid is liberated and escapes. Thus the material is brought back to its original condition, excepting that for muriate of lime has been substituted precipitated sulphate of lime, having the same affinity for carbonic ammonia as the muriate has. In warm weather this revivification takes place in a very short time; but in winter it requires the aid of artificial heat. The same purifying material is capable of being used nine successive times without any appreciable diminution of its power; and at last becomes inefficient only from the accumulation of ammoniacal salt, which can be removed by simply washing. The result of this process on the gas is to remove one equivalent of carbonic acid for one and a half of ammonia, and one and a half of sulphuretted hydrogen. But as the gas contains more sulphuretted hydrogen than ammonia, and more carbonic acid than sulphuretted hydrogen, it is necessary to submit it a second time to a material like the former, but with an excess of hydrate of lime. Here the sulphuretted hydrogen still left seizes on the oxide of iron, the carbonic acid being absorbed by the lime.—*Athenæum*, No. 1176.

HOT-AIR APPARATUS.

Mr. J. Nasmyth, of Lille, France, engineer, has patented certain improvements, which consist principally in a mode of Heating Air for warming buildings, apartments, conservatories, &c., also for drying goods, and other processes. The apparatus comprises a number of metallic chambers, or, more properly, channels, surrounded by a furnace, and arranged in such manner as that the products of combustion and heat shall play around them. These chambers are open at bottom to admit a current or currents of air, and at top communicate with pipes, through which the heated air is conveyed and applied as required.

HOT-AIR ENGINE.

A paper has been read to the Institution of Civil Engineers, descriptive of Sir G. Cayley's Hot-Air Engine, by Mr. W. W. Poingdestre. After entering briefly into the theoretical considerations of the expansion of heated aeriform bodies, and detailing the attempts made by Lieut. Ericcson for employing hot air, instead of steam, as a prime mover, the author proceeded to state, that in 1837 Sir G. Cayley applied the products of combustion from close furnaces so that they should act at once upon a piston, in a cylinder, similar in every respect to that of a single acting steam-engine. The engine consisted of a generator of heat, a working cylinder, and an air-pump or blower,—the air-pump being half the size of the cylinder, and blowing air into and through a fire perfectly inclosed within the generator. The doors of the furnace were made perfectly air-tight as soon as the fire was well got up: the first impulse being given to the engine by throwing a few jets of water upon the fire, which caused the air-pump to work immediately, and continued so for hours, the fire being replenished by stopping off the blast from the furnace, and opening the upper bonnet. After the air had passed through the fire, the gaseous products of combustion, generally at a temperature of 600° Fahrenheit, passed laterally through a chamber, used for separating them from any ashes or cinders, into the working cylinder before alluded to. The difficulty attending this description of engine was, the liability of the working parts to be deranged by the great sensible heat destroying the valves, pistons, and cylinders, and carbonizing the lubricating oil. It was stated, that Mr. A. Gordon had made a successful experiment on the application of the heated products of combustion for propelling a boat, without the intervention of any machinery between the furnace and the water to be acted on.

ILLUMINATING GAS FROM BITUMEN.

This invention is stated to consist in having obtained from compact and fluid Bitumen, asphaltum, chapapote, and mineral pitch, a new illuminating gas, which the inventor denominates "Kerosene Gas." This gas differs from all other illuminating gases, for as the bitumen contains no sulphur or nitrogen, it is free from sulphuretted

hydrogen, sulphurous acid, sulpho-cyanogen, cyanogen, ammoniacal gas, and azote, and its relative quantities of carbon and hydrogen differ from those of the gases heretofore used for the purposes of illumination.—*Franklin Journal.*

PAYNE'S NEW LIGHT.

The following is Mr. Payne's process: Water is decomposed by the chemical action of sulphuric acid on zinc, and the hydrogen passed through spirits of turpentine. The annexed letter from Mr. Mathiot, of the United States Coast Survey, places the question in an intelligible light.—

"Mr. Mathiot says:—'I next directed my attention to ascertain the quantity of turpentine used along with a known quantity of hydrogen. I first accurately measured a portion of turpentine, and then passed the gas from 33 oz. of zinc through it, burning the gas at the jet all the time. I then again measured the turpentine, and found it not perceptibly less than before. Now, in this case, the hydrogen could not have been changed into carburetted hydrogen, for coal gas contains from four to five times as much carbon as hydrogen, and pure carburetted hydrogen has six times as much carbon as hydrogen; and as 33 oz. of zinc, by solution, liberate one ounce or twelve cubic feet of hydrogen, therefore from four to six ounces of turpentine should have been used up, supposing it to be all carbon; but turpentine is composed of twenty atoms of carbon to fifteen atoms of hydrogen, and, consequently, only one-seventh of its carbon can be taken up by the hydrogen, or, in other words, forty-two ounces of turpentine will be required to carburet one ounce of hydrogen. Yet, still thinking some portion of the turpentine might be evaporated, I cooled the bottle with the turpentine, and placed the whole apparatus in a cold bath, and tried the experiment over again, but the light was the same. I then heated the turpentine to 120 degrees, and then passed the hydrogen through it, but the light was the same. I then took a half-gallon tincture bottle, and put in nearly three-quarters of a pint of turpentine, and let the pipe from the hydrogen generator run quite to the bottom of the water—the light appearing the same, or a little better. I have used the same lot of turpentine in all these experiments, having had a brilliant light for about three hours; and the turpentine, though frequently poured from one bottle to another, is not a teaspoonful less than before I began the first experiment. I have now announced to you the simple facts of the matter; the rationale I leave to the scientific world. The next step, after ascertaining that hydrogen can be used for illumination, is, whether the light is according to its weight or its bulk, as compared with coal gas,—that is, whether 200 cubic feet of this catalyzed hydrogen will go as far for light as 200 feet of coal gas, or whether it will require 200 feet, one pound of hydrogen, to do the work of 26 feet, one pound of coal gas.'"

Notwithstanding this statement, we are convinced that the hydrogen does rob the turpentine of carbon; but possibly the carbon lost is substituted by some other element,—and the character of the turpentine changed, although the quantity may not have been reduced. The above statement renders the cost easily calculable.—*Athenæum*, No. 1194.

PRODUCTS FROM PEAT.

Mr. William Benson Stones, of Golden-square, Middlesex, has patented certain improvements in treating peat and other carbonaceous and ligneous matters so as to obtain products therefrom.

Claims.—1. A machine for compressing peat.
2. A process of carbonizing.

3. The application of carbonic acid gas to the extinction of glowing char-peat.
4. The employment of peat-gas produced during the operation of carbonizing, for the purpose of heating the retorts.
5. The application of a series of receivers to the distillation of the residuum, and the obtaining products therefrom.
6. A process of obtaining "peatole" and "peupion" by rectification.
7. A process of obtaining "peatine."
8. The application of sulphur and peat to the manufacture of bisulphuret of carbon, and application of the peat and sulphur residuum to the manufacture of gunpowder.
9. The manufacture of artificial fuel from anthracite and char-peat.
10. The impregnation of surface-peat with resin-oil, &c., for the manufacture of fire-lighters and revivers.
11. The purification of peat-gas, as described.
12. The obtaining of heat and light by the combustion of peat gas in atmospheric air, when a coil or plate of platinum is employed.
13. A peculiar construction of gas-burner, and application of these burners for the purpose of blow-pipes, &c.

IMPROVED LAMPS.

Mr. Read Holliday, Huddersfield, has patented several constructions of Lamps in which light is produced by the ignition of vapour evolved by heating some suitable spirit supplied to the burner from a reservoir by capillary attraction.

The following are the principal features of novelty—

1. The use of two discs of cork, or other non-conductor of heat, to maintain the burner-tube in position, and impede the transmission of its heat to the glass or earthenware reservoir of spirits.

2. The employment of a cock or tap situated below the jet orifice, for the purpose of regulating the supply of vapour to the burner. Several arrangements are specified to be used, instead of the cock, having for their object a like purpose, namely, the regulation of the supply of vapour. One consists of a fixed spike, which passes through an opening in the bottom of the burner-tube, and, as the latter is moved up or down, increases or diminishes the size of the opening, and therefore of the supply of vapour. This spike also serves to clear the jet orifice. Or, a valve with a conical passage, which answers the double purpose of regulator and jet orifice, may be made use of.

3. The employment of perforated burners and wick-tubes for the admission of air to the vapour.

4. Enlarging the lower part of the burner underneath which the wick is to be spread out, for the purpose of increasing the heated surface. Also, the use of a two-legged wick-tube, through which the wick is drawn, or of two wicks for obtaining a like effect.

5. Various modifications of the preceding arrangements are described, whereby two or more burners are combined in one lamp, or the vapour supplied from two or more sources is centred in one light.

6. Regulating the admission of air to the vapour by making the burners to turn round the top of the wick-tubes, and perforating such portions as are in contact with each other, so that when the

holes are coincident the supply of air will be at its maximum, which will be gradually decreased as the burner is turned in one or other direction, and will be totally cut off when the perforations of the one come opposite the unperforated portions of the other.

7. Several methods of constructing the burners and wick-tubes, to admit of their being cast in one piece.

8. The adaptation of an adjusting screw to the wick-tube, to compress the fibres between it and the side of the tube, for the purpose of regulating the supply of spirit to be vaporised.

9. The patentee proposes to employ an arrangement, similar to that last mentioned, in pressure spirit lamps, for the purpose of compressing more or less the fabric through which the spirit is generally filtered and supplied from the reservoir to the burner.

LIMITS TO THE VELOCITY OF REVOLVING LIGHTHOUSE APPARATUS.

Mr. Ewan, in a communication to the British Association, at their late meeting, having referred to the well-known fact that the impressions of light remain for a definitive portion of time, about one-tenth of a second, said, that no experiment, as far as he knew, had been made as to the time required for making the impression. His experiments had been undertaken with this view. The brightness of the impression he found to be in proportion to the time of making it. When the time was one-fiftieth of a second, for example, the brightness of the impression was about one-tenth of the brightness of the full light. From this Mr. Ewan inferred that the light could not exceed a certain rate of revolution, otherwise a sufficiently vivid impression could not be made upon the eye.—*Athenæum*, No. 1190.

POWERS OF MINUTE VISION.

Mr. W. Petrie has communicated to the British Association a paper upon this inquiry. The following are the results from experiments for determining the best sort of station-marks, and the errors liable, in observing with optical instruments that measure on the principle of bringing two reflections together. The experiments were performed in bright daylight (but not sunshine), being light of the maximum of advantage for perceiving black against a white ground. The general circumstances of the experiments were arranged rather to determine the facts of common practice, than the theoretic powers of vision. The author then detailed the various distances at which circular spots, lines, &c., white on black as well as black on white, could be seen, the distances being given in terms of the breadth of the object seen. An arrangement of lines was described, by which an alteration of their position to the extent of only *one millionth* part of the distance of the observer was made visible. One result of the experiments would be to show what should be the proper proportions of parts to be observed in forming *letters* to be read with the greatest distinctness at a distance,—a subject of much practical use in the present day, and admitting of

a strictly scientific system, although generally left to the fancy of incompetent persons. *White* letters on a *black* ground should have their component lines of only half the breadth that *black* letters should have on a *white* ground. The direction of the eye, while appearing to gaze *steadily* at any object, does in reality keep *wandering* to an imperceptible distance on every side of the object looked at, but very rapidly. This *wandering* is not accidental or an imperfection of sight, but an essential feature of vision; because it is not the *continuance* of an impression that is perceived (by any of the animal nerves), but its commencement and termination, or, more strictly speaking, its increase and decrease. This principle is probably analogous to that by which a magnet creates an electric current in a neighbouring wire: not by its *constant presence*, but by the increase or diminution of its influence, either by a variation of its *power*, or of its *position*. This wandering propensity of the eye was shown to account for the relative facility with which different sorts of marks were seen at great distances: it takes place, apparently, in a minimum case, to the extent of an angle of 1 in 2,500. A dislocated linė (as in a vernier), its *falt* being half its breadth, can be perceived to be so at a distance of 10,000 times its falt, if black on a white ground; and at 12,000 times, if white on a black ground. It shows itself, however, by giving the line a *less steady* appearance, than a perfectly even line would have, when narrowly watched, by running the eye along the line, at about half as far again. Experiments were then described, on the visibility of the positions of the *ends* of lines, and of *hiatuses* in lines, and of *square* dots as compared with round. But the last conclusion of practical importance was in respect of observing the angular position of station-marks, or of stars, by reflection, as in a sextant. From these experiments it appeared that the position of two closely adjacent dots or images, in sensible parallelism to a given direction, while it affords one of the *simplest* kinds of observation, is more accurately observable than their actual coincidence, or even than the junction of two lines, as if in a vernier.

"GLASS PENS."

MR. R. W. THOMSON, civil engineer, claims for this invention on four distinct grounds:—first, that it can stand rust, which steel cannot; second, that it defies acids, which steel does not; third, that it bears the friction of writing better than the best steel ever produced; and fourth, that its strokes, though not so cutting nor so heavy as those of steel, are much finer, much clearer, and of a uniformity altogether unapproachable by either steel or quill.

In its simplest form, this new instrument consists of a plain glass tube, with a capillary bore of about the one thirty-second of an inch, which has been blown at one end into a bulb, having very much the appearance of a parrot's beak. The thick or enlarged part serves as a reservoir or fountain for the ink, and the point or nib as the pen, there being a free communication as well between

the fountain and the nib as between the fountain and capillary channel. The fountain is filled by inserting the point of the instrument in a quantity of ink, then applying the mouth to the top, and sucking out the air, the place of which is instantly occupied by the ink. When the mouth is withdrawn, the restored pressure of the atmosphere prevents the ink from rising in the tube, so that the instrument may be tossed about or even inverted without any risk of the ink escaping.

Artificial exhausting pieces are sometimes attached to the head of the instrument, to supersede the necessity of using the mouth; or forcing pistons, used after the manner of the ordinary fountain pens; and sometimes also the instrument is made in part only of glass, and in part of other materials.

GLASS IN DECORATIVE ART.

In No. 399 of the *Builder*, we find a brief account of recent successes of British Decorative Art in Glass; whence we select the following:—

First are the inventions of Miss Wallace, which consist, in principle, of imitations of gold and silver in glass, without the use of either metal,—of the protection of actual gilding or silvering under an almost invisible, yet magnifying coat of glass,—of a peculiar mode of adding metallic and pearly brilliancy to colours, to painted and stained figures, and to engravings, all in glass,—of imitations of marbles, alabaster, malachite, &c. in glass covered compositions—of imitations of precious stones,—and of other inventions.

Among the various forms under which these are brought into use, in architectural decoration, by Mr. Holtorp, to whose management they are committed, are those of ceilings, in which a combination of them, with a peculiar mode of enamelling in white or pale blue on the inner surfaces of the interspaces in glass (another of this lady's numerous inventions, also applied with good effect to framed engravings), is capable of producing a dazzling effect, particularly by night, with a good, or even an indifferent light, reflected on it. Mouldings and cornices are made, to harmonize with these effects, and the same combinations, varied with the pearly brilliance of painted flower-wreaths, and wreaths of silver engraved on a gold surface, all in glass, are made to adorn the walls in form of picture-frames. Besides a number of these productions, in varied detail, we saw a specimen of stained-glass decoration for windows, in form of armorial bearings, in vivid colours, made peculiarly sparkling and brilliant, and, in some phases, pearly, by one of the processes already alluded to.

One great feature in most of these inventions is, that the materials wherewith the effects are produced, wherever these consist of gilt copper mouldings, or even gilt paper, velvet, &c., are all protected, mostly within hollow mouldings of glass hermetically sealed, so that the gilding, &c. can never tarnish, and the whole is in this respect

everlasting. So is it with the marble imitations, which are so firmly imbedded in composition that they are said to be quite well adapted to all the risks of exterior construction, for which they are designed, as well as for chimney-pieces and other forms of interior decoration.

Miss Wallace has proposed to the International Exhibition Commissioners, that the hall of glass be allowed to remain as a winter garden, open to the public, and be decorated at small cost by her processes. She also expects to be able to exhibit, in 1851, specimens of glass deprived in great measure of its brittleness.

The next inventions to be noticed are those of Mr. Hale Thomson, which, in principle, consist chiefly of a new mode of silvering all sorts of curved or other surfaces of glass, differing from Mr. Drayton's, inasmuch as the nitrate of silver is held in a certain saccharine solution instead of oil of cloves; thus insuring, it is said, purity and permanence of colour. By an ingenious mode of moulding, the silver is lacquered on the glass *between* the outer and the inner surfaces, wherever, as in vases, cups, or other vessels, a double surface is shown. The silver *diaphragm* or midriff, if we may be allowed so to call it, shining through the glass according to its colour, produces similitudes of silver cups lined with gold, or purely of silver or of gold, so perfect in appearance as to have deceived the eye of a gold and silver smith; also ornamental vases and cups, which vie with the ruby, amethyst, jacinth, emerald, and other stones, in their vivid reflections of colour. The only application of this invention, as yet, to purposes more immediately architectural, at least which we observe, consists of door-plates, with imitation knobs, apparently convex, but really concave, and cut into the glass, with a colour like brass—a mere curiosity. Candlesticks show, however, what may be done in ornamental pillars, cornices, or other decorations in apparent silver, gold, or translucid coloured stone. Metallic reflectors for light-house, railway, astronomical, or other purposes, protected, of course, by a glassy surface, merit notice from their brilliance.

In the forms to which these inventions have been applied there may yet be great improvement.*

Mr. Kidd's process for illuminating, silvering, decorating, and embroidering glass girandoles, cheval, toilette, and other ornamental articles in glass, remains to be noticed. We have here the hitherto plain surfaces of mirrors, &c., first engraved, or, as it is called, embroidered, in patterns, such as wreaths of flowers, by a new process of art, consisting of lathes with needle-points for engraving, whereby, as in some of those already alluded to, a superior style of engraving on glass has been realized; constituting, in fact, a new branch of art. In this case, Mr. Kidd has succeeded in silvering the engraved

* Most of the articles we have seen, especially the cups, are clumsy, from the thickness formed by the double surface; some of the "plate" has also a *quicksilvery* appearance; the general effect of the colour and metallic coating is garish and gaudy; and the chances of breakage do not seem to have been taken into account.—*Ed. Year-book of Facts.*

surface by a process not chemical like those of Mr. Thomson and Mr. Drayton, and the effect is excellent. The engraving, though on the inner surface of the glass, appears, in fact, as if raised upon the surface. In this way, crests, armorial bearings for chairs and panels, and a variety of other decorations, can be effected either in clear or coloured glass, as well as flower wreaths, fruit, landscapes, &c.; so that a new field is thus opened to artisans; and, when the means of embedding such art works solidly, and of protecting them from atmospheric and other injurious influences, are considered, the fragility of glass is in a great degree obviated, and the permanency of the work secured.

MACHINE FOR CUTTING GLASS SHADES.

Mr. A. Claudet has described to the Society of Arts, a certain Machine invented by him, in which the Diamond is made to perform what by manual labour had before been very imperfectly done. This machine was contrived for cutting Glass Shades; to effect which, so that they should stand perfectly firm, and with an *even base*, was a most tedious and imperfect operation when done by hand.

The principle of the machine, expressed in the fewest words, is this:—The shade is firmly fixed between an internal support and a transverse bar above it, in a perfectly upright position, above a horizontal, level, and smooth table, its bottom being a few inches above the table. Upon the table travels a small but heavily-weighted base moving on castors, having springing from it two upright pillars, one holding the diamond, and the other forming a support opposite to it. The pillar holding the diamond is fixed, but the other is moveable, being by a spring kept close to it. The height of the whole is such that when on the table the diamond is about an inch above the bottom of the shade. The diamond being introduced inside the shade as it hangs suspended, the pressure of the spring is sufficient to cause it to cut, and it has only to be moved round the shade, the horizontality of the table causing the cut to be perfectly level. This machine was exhibited, and the bottoms of shades cut by it before the meeting. The shape of the shade, whether oval, round, or square, is unimportant in the use of this machine; but Mr. Claudet has contrived another for the cutting of round shades only, in which the shade is laid horizontally,—an elegant system of adjustments being provided, by which shades of any diameter can be cut by the workman with little risk of error.

The largest glass shade ever produced was lately blown at Birmingham, by an English workman. It is 62 inches by 26½ inches in diameter, and contains nearly 40 lbs. of metal. Until lately, a Frenchman was considered the most skilful workman in the employment of Messrs. Chance, in whose manufactory the shade alluded to has been blown. A secret in blowing great glass bubbles is described in *The Builder*. It consists simply in moistening the mouth with a little water before blowing. The water is converted, in the interior

of the drop, into steam, which vastly aids the breath in extending the dimensions of the "bell."

SEWAGE OF TOWNS.

COL. THE HON. C. GREY has communicated to the Council of the Royal Agricultural Society of England, for their consideration and inqury, should they think the subject worthy of it, what has struck his Royal Highness Prince Albert as being a simple plan for effecting the Sewage of Towns. Leaving it to more competent judges to decide whether the sewage should be used as a liquid manure, or solidified, upon which point his Royal Highness wished to give no opinion himself, he had confined his consideration to the latter mode of application, for two reasons, namely, that in solid form: 1. It could be more easily transported. 2. It could be obtained at the least possible expense. Col. Grey then proceeded to describe the plan proposed by his Royal Highness, which was simply this:—to form a tank, with a perforated false bottom, upon which a filtering medium should be laid; and to admit at one end the sewage into the tank, *below* the false bottom, when, according to the principle of water regaining its own level, the sewage liquid would rise through the filtering bed to its original level in the tank, and, provided the filtering medium had been of the proper nature and of sufficient thickness, it would be thus freed from all mechanical impurity, and would pass off into the drain, at the other end of the tank, as clean and clear as spring water. This simple and effective plan was illustrated by drawings, showing the vertical and horizontal sections of the tank, and by a neatly constructed model of its external form and internal arrangements. It was clearly shown by these sections, how the sewage matter could be let into the tank, or shut off, when necessary, in the simplest manner, by means of common valves; and with what facility such a filtering tank might be applied to every existing arrangement of sewers, without requiring any alteration in their structure. The filtering medium having abstracted from the sewage all extraneous matter, would, in all probability, become the richest manure; and could, at any time, by stopping the supply of sewage, be taken out by a common labourer with a shovel, and carted or shipped to any place thought most desirable. The solid matter, too, held in suspension by the sewage, would probably form a very rich deposit at the bottom of the tank, of a substance approaching in its qualities to guano, and could be extracted by removing the false bottom, which rested on arches or vertical supporters over the sewage below it in the tank, and could be easily made to lift up or take out for the purpose of such extraction. Two tanks might easily be constructed together, so that one might continue in operation while the other was being emptied.

The experiment might be tried at any house-drain in town or country: in fact, his Royal Highness had himself tried the operation on a small scale with apparent success; and while he thus sug-

gested an important and extensive application of the hydrostatical principle involved in the plan proposed, he wished to lay no claim to originality in the adoption of that well-known law of fluid bodies by which they make an effort, proportionate to their displacement, to regain their original equilibrium. On that principle was founded, as he was well aware, the upward-filtering apparatus used by the Thames Water Companies. The Prince's great object was, by the simplest possible means, to attain a great end ; to effect an essential sanitary improvement, and at the same time to create a new source of national wealth by the very means employed for the removal of a deadly nuisance, and the conversion of decomposing matter highly noxious to animal life into the most powerful nutriment for vegetation. His Royal Highness, too, wished to offer no opinion on the details required to complete the plan proposed, or on the mode of carrying it out in the most effective manner. Supposing it to be right in principle, its advantages in an economical point of view could only, his Royal Highness conceived, be ascertained by practical experience ; and it was on that account that he wished to submit it to the consideration of the Agricultural Society, who might be better able to carry out the necessary experiments. It would remain to be decided what is chemically or mechanically the best and what the cheapest substance for the filter ; what the best and cheapest construction of the tank ; how long the sewage will pass before the filter becomes choked ; and how soon the filter could be sufficiently saturated to make it profitable as a manure. His Royal Highness had used as the filtering medium the following substances :—

1. Charcoal :—admitted to be the most perfect filtering substance for drinking water, retaining effectually extraneous matters, and well known for its singular powers of purification. 2. Gypsum (plaster of Paris, or sulphate of lime) :—recommended by agricultural chemists for fixing ammonia and other volatile substances, by the decompositions to which it becomes subject when exposed to the action of volatile alkali. 3. Clay :—in its burnt state, would act mechanically as a filtering bed ; and in its unburnt state, on account of its aluminous salts, has also the property, like gypsum, of fixing ammonia, or of decomposing the ammoniacal and other alkaline salts present the manure : and in either state would be cheaply procured.

All these substances, his Royal Highness thought, would in themselves be highly useful as manures, independently of the purpose they would subserve as agents for filtration, or for the additional amount of manuring matter they would receive from the sewage which they purified. His Royal Highness, however, in thus incidentally referring to the substances he had himself employed for the filtering medium, was well aware how many more of equal, if not superior, value would suggest themselves to others, who, like himself, felt an interest in effecting the important object proposed. As he had given no opinion on the general question of the liquid or

solid application of manure, but had merely stated the grounds of preference, in a practical sense, of the solid form over the liquid for the purpose of the filtering operation under consideration, his Royal Highness entered into no discussion of the amount of manuring matter retained by the filter compared with the soluble matter that might pass through it along with the water, and remain in that liquid in a soluble, colourless and transparent form; nor of the value of such filtered water for agricultural purposes. He had confined his observations to the agricultural value of the filtering bed, and the rich deposit obtained in the purification of sewers for sanitary purposes."—*Athenæum*, No. 1175.

NEW SUBSOIL DRAINING PLOUGH.

THIS is the invention of Mr. John Fowler, of Melksham, Wilts. It is a new species of mole plough constructed throughout of iron, and with a careful application of the principles of mechanical engineering to every detail. The draining pipes, which may either be of clay or wood, are strung upon a rope of sufficient length, one end of which is attached to the bed of a mole affixed to the bottom of a strong vertical coulter. This coulter is capable of being adjusted to any depth not exceeding four feet, and thus, through the tunnel formed by the mole as the plough advances, the rope, with the pipes upon it, is drawn until the whole length is laid. The tractive power is a moveable capstan, worked by horses, or a portable steam-engine may be applied. By the means provided for raising or depressing the capstan, a uniform line is given to the drain, notwithstanding undulations of the surface, and precautions are also taken to secure a continuous fall on a dead level. By the help of a long iron frame, all the difficulty experienced in getting the old fashioned mole plough to act regularly is overcome, and an even distribution of the strain upon the whole implement is secured. Mr. Fowler calculates that by such a machine, three horses, three men, and four boys, will be able to lay about 4000 feet of draining per day, and at an expense one-third less than the present cost. In its construction this plough is a great improvement on that hitherto in use, as the old mole plough carried no pipes in after it to arch in the tunnel which it had formed. The one machine makes a perfect durable drain, while the other, under the most favourable circumstances, only makes one to last for a few years. In the application of such an implement as the mole plough, difficulties will arise from irregularities in the surface, or in the texture of the soil to be dealt with, which are exceedingly difficult, if not impossible, by any amount of ingenuity to overcome; as where large stones stop its progress, or where the undulations of the land are rapid and frequent. There are, however, large tracts of heavy clay and bog where such an implement as this in good working order would be of great value. Mr. Fowler's invention, when put to the test, so far satisfied the expectations entertained of it, that it laid pieces of draining effectually at a depth of 2½

feet and 3 feet, the old mole plough not going lower than from 18 inches to 20 inches.—*Expositor*, No. 3.

LORD WILLOUGHBY DE ERESBY'S STEAM-PLOUGH.

THE machinery employed consists of the "California," a locomotive engine, weighing $3\frac{1}{2}$ tons, and of a twenty-six horses power, designed by Mr. Gooch. It has a double capstan attached, removable when the engine is required for other purposes.

The engine moves across the centre of the field on a light portable railway. The ploughs advance and recede on either side of the railway, at right angles to it.

The plough employed consists of four ordinary, and the like number of subsoil ploughs, fixed in a frame: it is directed by a person standing upon a small platform.

Two such ploughs, one on either side the railway, alternately advance and recede; the advancing plough working, the other idle until it regains its proper position for ploughing the next four furrows. On the completion of the four furrows both ways, the engine and side frames advance each three feet.

The ploughs are attached to an endless chain, 150 yards in length. They can be detached at pleasure, or shifted from one side the chain to the other. They travel at the rate of five miles an hour. Provision is made in case they strike against any impediment. There is also a provision on the carriage for tightening the chain at the fences, by which the length may be varied forty feet, to suit irregularly-shaped fields. If any further alteration is necessary, the chain is made in thirty feet lengths, one of which can be added or taken out as required.

The full power of the engine is not exerted with the ploughs above described; and the number of blades can therefore be increased, if experience proves it to be advisable.

In the present state of things it is difficult to form a correct estimate of the value of the invention in a commercial point of view. A machine of the power, and with the arrangements described, would perform the work usually done by sixteen ploughs, driven by as many men, and drawn by thirty-two horses. Requiring itself the attendance of eight men, and a horse to draw the water for the engine, it would thus save the labour of thirty-one horses and eight men. Against this must be set an expense of five shillings a day for coals, as well as 10 per cent. upon the value of the machinery, say three shillings a day upon an original cost of 550*l*. to 500*l*. This latter item, however, would be fully compensated by the saving in the interest of capital now laid out on horses.

The machinery is only calculated for the cultivation of flat land. It might possibly be used with advantage in the West Indies. (See Illustrations of the Invention, published by Ridgway, Piccadilly.)

THE FLAX MANUFACTURE.—STEEPING SUPERSEDED, AND THE FIBRE ADAPTED TO COTTON SPINNING MACHINERY.

ONE of the greatest obstacles which has hitherto stood in the way

of an extended cultivation of flax, viz., that of the trouble, delay, and expense attended upon its steeping, in order to prepare it for the market, has now been removed, by an invention which entirely dispenses with that process, and enables the grower at the smallest possible cost to send his fibre into the market. By this process, of which Mr. Donlan is the inventor, the results are obtained by a combination of chemical and mechanical means; and as it avoids all the expenses connected with steeping, the fibre may be prepared at a cost considerably below that incurred in the present process; and may be made, we are assured, applicable either for fabrics of the coarseness of nail bags or canvas, or of the fineness of the most beautiful Brussels lace. Not only is the expense considerably less, but the time consumed in the preparation of the fibre, which, by the old process, ranges from ten days to three weeks, does not exceed as many hours by the unsteeped mode. It also possesses a vast superiority on account of the extreme simplicity of the means adopted, which may be made intelligible to and performed by a mere child. But by far the most important and valuable part of this invention is, that it produces a fibre perfectly clean, and in its natural state, without any of the stains or impurities which necessarily attach themselves to the fibre during the process of steeping; and it also possesses the advantage of securing that regularity and uniformity of strength which to a greater or less extent is wanting in the steeped fibre. Application has been made for a charter of Incorporation for a Company which will be ready to purchase the flax produced upon 100,000 acres in Ireland, at 12*l.* per acre, and to prepare it for the market in cases where the grower may not possess the necessary facilities for preparing it himself.

The uniformity of strength and freedom from stain or impurity which exists in the flax prepared by the unsteeped process, has, within the last four days, led to the practical demonstration of an invention, of the value and importance of which, to the agriculturists and manufacturers of this country, it is impossible to form any adequate idea, and which consists, among other things, of the adaptation of the flax fibre to cotton machinery. The patentee of this invention is M. Le Chevalier P. Claussen, member of the Brazilian Institute, well known as the inventor of the circular loom, and by his collections of objects of natural history and plants of South America in the British Museum, and in the Museum at Paris. We had placed in our hands a quantity of flax rovings and yarns spun upon cotton machinery by the inventor, and we have had an opportunity of personally inspecting at Manchester the whole process connected with the invention, and the result has fully convinced us of its practicability. The first portion of the yarn spun, in our opinion, and we were confirmed in it by a gentleman of great experience and long connection with the cotton trade, was equal in fineness to 120's cotton, the coarsest being equal to 50's. The application of such a test as that of 120's for the first time was certainly a most severe one: the result, however, was perfectly successful. A

slight difficulty arose at first with the machinery, in consequence of the length of the fibre: this, however, was easily obviated by a slight alteration in the position of one of the rollers. As the fibre, however, may be prepared to any length, there will be no necessity in future for even this alteration, the existing cotton machinery being perfectly adapted for the purpose of spinning flax prepared according to the process patented by M. Claussen.

The patent granted to M. Claussen for England is for the preparation of flax in a short staple, so as to produce a substitute for wool and cotton capable of being spun upon cotton machinery; and also for the mixture of the materials thus obtained, which can be carded together with silk, cotton, or wool, or separately, as cotton for spinning into yarns. The right is likewise secured for preparing long fibre as a substitute for silk, for bleaching in the preparation of materials for spinning and felting, and also in yarns and felts. The inventor does not, however, confine himself to flax for the purpose of producing a fibre adapted to his purpose, but states that he can obtain similar results from hemp, jute, Chinese grass, and, to use his own expression, from "an old tar rope, or a bamboo cane."

As the patents are not yet secured for several Continental states, we are not at liberty to state the nature of the process, or the means adopted for the purpose of bringing the fibre into the required state. We may explain, however, that from 1¼ cwt. of the flax fibre prepared and cleaned upon the unsteeped process, 1 cwt. of a substance, identical with clean cotton, can be produced at a cost for materials of less than half-a-crown. The cost of manual or mechanical labour required in its preparation, including the expenses of bleaching, an operation performed in a few seconds, does not amount to more than seven-sixteenths of a penny per pound.

The mixture of the two substances, viz., wool with flax reduced to a short staple, forms a fabric exceedingly durable, while its cost may be judged by the fact, that while wool costs 4s. 6d., the flax prepared and ready for spinning may be obtained for 6d. per pound: so that with flax and wool spun together in equal quantities, the cost would be reduced by nearly one-half.

But although the inventor has obtained a patent for the preparation of a fibre as a substitute for cotton, he does not indulge the visionary and impracticable idea of being able to drive cotton out of the markets; his object being simply to provide a substitute for low cottons, in the manufacture of a variety of fabrics in which that valuable and over-wrought material now forms a part. In a branch of our trade, however, for the supply of which upwards of 770,000,000 lbs. of cotton were last year imported, it is not too much to suppose that there exists ample room for the consumption of very large supplies of home-grown flax, while the facilities which are now found to exist for carding and spinning together flax and wool, must also tend to open up new sources of demand among the manufacturers of Leeds and Bradford.—*Morning Chronicle, Nov.* 14.

From the "Prize Essay on the Cultivation of Flax in Ireland."

by Mr. James M'Adam, Secretary to the Royal Society for Promoting the Growth of Flax, it appears that the profit to the grower upon an acre of flax grown and prepared upon the present system is 10*l*. Out of this sum, however, the grower has to pay—for steeping, taking from steep, spreading, turning, lifting, and scutching—a sum of nearly 4*l*. Application has been made to the Board of Trade for a Charter proposing to take the flax in its raw state, exclusive of the seed, at the price of 12*l*. per acre, the grower being thus saved the whole expense attending upon the steeping process. On the other hand, if the grower possesses the facilities of preparing the flax, he will be at liberty to dress it upon the patented mode, upon taking a license from the association, and will be enabled to bring it into a state fit for the market, without the expense and risk incurred by the steeped process.

The subject of an extended cultivation and improved preparation of flax is now occupying the attention of most of the Governments of Europe, as well as of the United States. The offer made by the Government of Holland for the purchase of an invention, connected with the preparation of the fibre, to which we have already referred, shows in the most convincing manner the importance which is attached to it by that Government.

M. Payen, the French chemist, has, deputed by that Government, visited Ireland, in order to inspect and report upon the mode of cultivation and the preparation of the fibre in that country. In his report to the Government, M. Payen describes the movement in favour of an extension of the growth of flax, and the probable substitution of linen for cotton, as an "industrial revolution which was fast maturing itself." The President, in his message to the Legislative Assembly, under the head of "Agriculture and Commerce," alluded to the inquiries which had been thus set on foot, and announced the intention of the Government, in accordance with the recommendation of the report of M. Payen, to submit to the Legislature a bill calculated to extend and facilitate the growth of flax in France.

The British Government, in considering the application for a Charter to encourage the growth of flax in Ireland, has very properly decided upon relaxing the rule by which they are governed in the case of the granting of charters under ordinary circumstances.

Mr. G. R. Porter, has read to the British Association, a paper "on the introduction of Flax for cotton in the manufacture of cloth," in which he observes:—Our supply of cotton has hitherto been drawn in very fluctuating proportion from British India, Brazil, Egypt, our West India Colonies, and the United States of America. From this last-named country the quantities were for a long series of years in a continual condition of increase. From Brazil our importations have sensibly lessened without any reasonable prospect of future increase. From Egypt the quantities fluctuate violently, and depend greatly upon causes not falling within ordinary commercial considerations. In the British West Indies, the cultivation

of cotton has for some time ceased to form a regular branch of industry; and it is hardly to be expected, that, having thus ceased to be profitable when prices in Europe were uniformly at a higher level than they have been for now a long series of years, the cultivation of cotton to any important extent will be resumed in these colonies. From British India the quantities received depend upon a different set of circumstances, but of such a nature as to forbid any sanguine hopes of great and permanent increase in the shipments.

As a remedy for these short and uncertain supplies, Mr. Porter proposes our home culture of flax, observing:—"An additional inducement to the growth of flax beyond that offered by other articles, may be found in the fact, that to bring it to the same condition as that in which it is usually imported from foreign countries, calls for the employment of a considerable amount of human labour. There is no part of the United Kingdom in which the flax plant cannot successfully be cultivated; and there is hardly any country where it might not be brought to supply our deficiencies, should such arise. It should not in any degree interfere with the prosperity of the present race of cotton manufacturers if flax were to be substituted in part for the material now employed by them. Some changes are doubtless necessary in order to adapt their present machinery for the spinning of flax, but not to any import and extent. It would not appear difficult so to order the arrangements of a spinning-wheel or a weaving shed that both flax and cotton might be included within its operations; and that the preponderance in those operations might be given from time to time either to the one or to the other, according to the capabilities of the markets of supply on the one hand, and the requirements of the markets of consumption on the other."—*Athenæum Report.*

THE HYDROSTATIC LOG.

The object of this invention is to obtain a register of the speed of ships, by a column of mercury, in such a manner that the height of the column shall depend upon the velocity alone, and not be affected by any disturbing causes; such as alteration of draught of water, pitching and rolling, &c.

The principle embraces that of Pitot's tube, inasmuch as the force of the resistance due to the velocity is communicated through a small pipe projecting into the water below the bottom of the ship: this force, acting upwards, compresses a portion of enclosed air in a small cylinder, which air communicating by means of a little pipe with the bulb of a glass tube—bent like a common barometer—raises the mercury in the tube, by depressing it in the bulb.

But as any single column of water and air thus acting upon the surface of the mercury in the *bulb alone* must depend not only upon the resistance due to the velocity, but also upon the *distance of the cylinder from the water-line*, which distance or height varies with every sea, and alters more permanently as the draught of water changes, a compensation was necessary; and the inventor has found

one, which he considers perfect for all these variations, by applying *a second column of water and air* to press upon the *other snrface of the mercury*, viz. that in the glass tube. This second column is precisely like the first as regards the pipe and cylinder, and communicates with the sea by an aperture or apertures, presented in such a direction that velocity does *not produce any increase of pressure.* Thus the mercury in the indicator is placed *between* two *columns* of water and air, which are *always equal to each other* in length; and the mercury rises according to the *difference* between the pressures upon its two surfaces, the result of resistance or velocity alone.

The air-pipes may be conducted in any direction, and the indicator, which swings upon gimbals, may be placed in any part of the ship. The two water-pipes are conducted into one tube in the bottom of the ship, divided into two separate chambers for the different forces.

In addition to the speed, the true course or leeway of the vessel is indicated upon a horizontal segment divided into degrees, over which a needle is moved by a rod connected with the above-mentioned double tube; and the whole is kept continually in the true direction of the ship's motion by a float or vane attached to the lower end of the tube in the water.—*The Rev. E. L. Berthon; Proceedings of the Royal Society.*

VESSELS BUILT ON THE WAVE PRINCIPLE.

Mr. Scott Russell has read to the British Association, a communication from Thomas B. Dogson, of the Brazils, who had constructed several vessels in the Wave principle; the results thus furnished showed an advantage over the common build of seven to eight in speed: while in a sailing vessel, the Titania of 100 tons, constructed in England on the same principle, the great power in withstanding a storm had been satisfactorily established.

The President of the Section, while he expressed the pleasure which he had in finding these wave principles carried out on the Continent, regretted that the great amount of information offered to the Admiralty on this subject in Mr. Russell's reports had not yet been accepted. It certainly would save much fruitless expenditure.

THE MARINE TELESCOPE.

This instrument, popularly named "the Water Telescope," from the power given by its use to see into the water, consists of a tube of metal or wood, of convenient length, to enable a person looking over the gunwhale of a boat to rest the head on to one end, while the other is below the surface of the water; the upper end being so formed that the head may rest on it, both eyes seeing freely into the tube. Into the lower end is fixed (water tight) a plate of glass which, when used, is to be kept under the surface of the water.

A very convenient size for the instrument is to make the length 3 feet, and the mouth, where the face is applied, of an irregular oval form, that both eyes may see freely into the tube; with an indenta-

tion on one side, that the nose may breathe freely, not throwing the moisture of the breath into the tube. Next is a round plate of glass, 8 inches diameter, over which is the rim or edge; this rim is best formed of lead, a quarter of an inch thick, and three inches deep; the weight of the lead serves to sink the tube a little into the water. Holes must be provided at the junction of the glass and rim, for the purpose of allowing the air to escape, and bring the water into contact with the glass; on each side there is a handle for holding the instrument. This size and form is very much that of the instrument brought from Norway by John Mitchell, Esq., Belgian Consul, of Mayville, with the improvement for excluding the breath, and allowing the water to get into contact with the glass, which was not provided for in that instrument.

The reason why we so seldom see the bottom of the sea, or of a pure lake, where the depth is not beyond the powers of natural vision, is not that the rays of light reflected from the objects at the bottom are so feeble as to be imperceptible to our sense, from their passage through the denser medium of the water, but from the irregular refractions given to the rays in passing out of the water into the air, caused by the constant ripple or motion of the surface of the water, where that refraction takes place. Reflections of light from the surface also add to the difficulty; and before we can with any just hope expect to see the objects distinctly at the bottom, these obstructions must be removed.

This is done to a very great extent by the use of the Marine Telescope: the tube serves to screen the eyes from reflections, and the water being in contact with the glass plate, all ripple is got rid of; so that the spectator, looking down the tube, sees all objects at the bottom, whose reflective powers are able to send off rays of sufficient intensity to be impressed on the retina, after suffering the loss of light caused by the absorbing power of the water, which obeys certain fixed laws, proportionate to the depth of water passed through; for as light passing through pure sea-water loses half its intensity for each 15 feet through which it passes,* we must, from this cause alone, at a certain depth lose sight of objects of the brightest lustre. The perfect purity of the water, and its freedom from all muddy particles floating in it, form an important element in the effective use of the water-telescope: for example, in the Frith of Forth, and similar estuaries, where the influx and reflux of the tide keep particles of mud in constant motion, the instrument is of little or no use; for these act in exactly the same way in limiting our vision through water, as a fog does through the air: it is therefore only in the pure waters of our northern and western shores that this contrivance is applied with any advantage; and in such situations we can speak of its powers with confidence. In a trial made with the instrument last autumn on the west coast of Scotland, the bottom was distinctly seen (a white bottom) at a depth of 12 fathoms; and on a

* Leslie's Elements of Nat. Phil. p. 19.

black, rocky bottom, at 5 fathoms under water, objects were so distinctly seen that the parts of a wreck were taken up—the exact place of which was not known previous to its use. In these experiments a lenticular form of glass was made use of at the bottom of the tube, having a plane surface to the water, but no great or marked advantage was observable from this construction. This contrivance for viewing the bottom of the sea is stated to be in general use in seal-shooting along our northern and western islands, where, sometimes in the form of an ordinary washing-tub, with a piece of glass fixed in its bottom, the shot-seal was looked for, and the grappling-hook let down to bring him to the surface. Our eminent engineer, the late Mr. Robert Stevenson, made use of the water-telescope more than 30 years ago, in works connected with harbour improvement in the north of Scotland; it has also been used to examine the sand-banks, &c., at the bottom of the River Tay, but in this case the mud prevented its use in any considerable depth of water.*—*Communicated by John Adie to Jameson's Journal*, No. 98.

MANUFACTURE OF SUGAR.

PROF. BRANDE has read to the Royal Institution, a paper "On the Theory and Practice of the Manufacture of Sugar." The Professor commenced by succinctly noticing the two types of the saccharine principle—Cane-sugar and Grape-sugar. He adverted to the sugar-cane, the beet-root, the maple, the maize, and the palm, as the chief sources of the former; and stated that the latter was found in the juices of fruits—in honey—and that it constitutes the sweetness of malt. The formula for sugar-cane is $C_{12} H_{11} O_{11}$—for grape-sugar, $C_{12} H_{14} O_{14}$. The ready and characteristic crystallization of cane sugar was contrasted with the tardily formed and obscure crystals of the grape-sugar; and the exclusive property of grape-sugar to reduce copper from its salts was experimentally exhibited. Cane-sugar in its raw state is a peculiarly unstable substance, and every decomposition it undergoes deteriorates its qualities. Therefore, the great object of the sugar-refiner is to remove impurities without sacrificing in the process the material of the loaf-sugar which he manufactures. Heat is an indispensable agent for removing these impurities. A model of a sugar-boiler, and a boiler itself, with its air-pump and steam-pipes, in actual operation, were exhibited, in order to show the method of boiling sugar *in vacuo*. The mode of taking samples without admitting air was explained. Extraneous substances being thus separated by boiling, the albumen in blood and the alkalescent properties of lime were formerly

* This instrument is not only used by the fishermen, but is also found aboard the navy and coasting vessels of Norway. When their anchors get into the foul ground, or their cables warped on a roadstead, they immediately ply the glass, and, guided by it, take steps to put all to rights; this they could not do so well without the aid of their rude and simple instruments, which the meanest fisherman can make up with his own hands, without the aid of a craftsman.

employed,—the one to entangle, the other to neutralize, the thick and acid impurities, and ultimately to separate them from the syrup; and charcoal was used to detach colouring matter. The new process by Dr. Scoffern dispenses with the use of lime and of blood. It is based on the affinity of oxide of lead for colouring matter, as well as for the melassic and other acids, all of which have to be removed from the syrup. Dr. Scoffern heats the syrup to 180° Fahr., and then mixes with it subacetate of lead,—a bulky precipitate of melassicate of lead is formed, and the syrup, more or less contaminated with lead, passes through the filter. The lead is then separated in the form of an insoluble sulphite by a current of sulphurous acid gas sent through the syrup. After the removal of the metal has been proved by the test of sulphuretted hydrogen, chalk is added to neutralize the acetic acid, and then the syrup is thus sent to the vacuum pan for granulation. Returning to the precipitate in the filter, Mr. Brande showed how the melassic acid might be separated from it by solution in alcohol and subsequent precipitation by sulphurous acid. In conclusion, he noticed the recently adopted use of sugar ground with water in place of clay to wash out the few remaining impurities which would otherwise tinge the colour of the lower part of the sugar loaf.—*Athenæum*, No. 1162.

Extensive preparations have been made at Lord Howard de Walden's estate, near Spanish Town, for carrying out M. Melsens' improved method of sugar-making. Considerable difficulty has arisen in the construction of the apparatus for making the bisulphite of lime, the principal agent in the new process on the estate. His Lordship has also sent out a machine for curing sugar, which fits it for sale or exportation the moment it is fit to take from the cooler. This machine is on the centrifugal principle, and is worked with the greatest facility by a strap from the steam-engine. We regret we cannot give a fuller explanation of its construction at present, as it is beyond doubt the greatest *practical* improvement which has ever been brought to Jamaica.—From the *Jamaica Standard*, April 2.

ADULTERATION OF ISINGLASS.

Of the several varieties of Isinglass which, in the unmanufactured state, are imported into this country, that called *Beluga leaf* is, according to a paper by Mr. Redwood, in the *Pharmaceutical Journal*, most esteemed for dietetical use; and this, when prepared and cut, constitutes the best Russian isinglass of the shops. There are inferior varieties of Russian isinglass, such as the *Samovey*, which, being much cheaper than the *Beluga*, may perhaps sometimes be mixed with it when cut; but as the jelly made from such deteriorated specimens would be proportionately weak, the admixture would be thus detected. Brazilian isinglass is a cheap kind, which is extensively used for fining beer, and for other similar purposes; and this is also prepared and cut, like Russian isinglass, and is no doubt sometimes mixed with the Russian. The Brazilian variety, however, is much less soluble in water than the best Russian,

and the jelly obtained from it is inferior in consistence, in transparency, and in flavour. When these different kinds of isinglass have been submitted to the processes of the manufacturer, in which they are picked and purified (especially the inferior kinds), rolled into *ribbons*, and subsequently cut, the prices at which they are sold, wholesale, vary from 6s. to 17s. a pound. The modern introduction of machinery has enabled the manufacturer to prepare the isinglass in much thinner shreds than was formerly the case when it was pulled to pieces by the fingers or cut with scissors. There are those, however, who still prefer to have it in the thicker pieces, in which state it is called *hand-cut*. The quality of cut isinglass is estimated —1st, by its colour, that which is cut fine by machinery being, *cæteris paribus*, the whitest and generally most esteemed; 2dly, by the smell emitted after breathing upon it, that being the best which is least disagreeable in this respect; 3dly, by the extent of its solubility in water; and 4thly, by the consistence, transparency, and flavour of the resulting jelly. Such practical method of examination is that alone by which slight shades of difference may be discovered; yet a difference of flavour which only a practised palate, or careful comparison with an approved specimen, could detect, is often important in an article intended for the diet of the fastidious invalid; and a slight superiority in this respect will, therefore, command a much increased price.

In April last, Mr. Warington submitted two samples of isinglass, one of which was suspected, to a careful examination. One he pronounced pure and genuine; the other, to have a great deal of acid adhering to it, arising either from acid having been used to improve the colour and appearance of an inferior isinglass, so as to render it saleable, or from its admixture with a gelatine prepared by means of an acid: in either case imposing both on the dealer and the consumer.

Mr. Redwood has also gone minutely into the inquiry. He says, from the results, it is evident that the specimen he examined consisted of a mixture of isinglass and gelatine; and optical examination showed that the two substances had been worked together in a manner well calculated to elude detection. He felt satisfied, and Mr. Warington had previously expressed the same conviction, that sheet gelatine had been rolled between two sheets of isinglass, in the moistened state, so as to form a ribbon, in which the two substances would be united. In order to get further evidence in confirmation of this view, he had some genuine isinglass and sheet gelatine, in the proportion of three parts of the former and one of the latter, rolled into ribbon and cut, under his inspection. The specimen thus prepared could not be distinguished by the eye from the best Russian isinglass. It agreed entirely with the adulterated article met with in commerce, not only in appearance, but in the characters presented when examined in the manner described in his paper. He feels fully justified, therefore, in the conclusion, that a most ingenious but unwarrantable system of adulteration is adopted in the manufacture of

cut isinglass; and he trusts that his exposure will enable those who deal in isinglass to detect the imposition, if its practice should be continued.

Messrs. Phillips and Cooper, on behalf of the parties accused of the fraud, dispute—but do not, we think, disprove—Mr. Redwood's results, or shake his conclusions.—*Literary Gazette.*

ADULTERATION OF COFFEE.

A PAPER has been read to the Botanical Society of London, by Dr. Arthur Hassall, "On the Adulteration of Coffee." The author commenced by observing that the injurious results which he was about to detail originated in a remark made in the House of Commons during the late debate on chicory, to the effect that no means had yet been discovered by which the adulteration of coffee with chicory could be determined. The recollection of the fact that in vegetable charcoal the component parts of the several tissues may be detected by the microscope, led Dr. Hassall to infer that by the same means the less completely charred vessels, cells, &c., forming the tissues of those substances employed in the adulteration of coffee might likewise be discovered—an expectation fully realized.

In this way it was ascertained that the substances most frequently used in the adulteration of coffee are chicory, roasted wheat, colouring matter, and occasionally beans and potato flour. The structure of the coffee-berry and of the several productions just named was then minutely described; and it was shown that the chicory might at all times be distinguished with the greatest ease by the size and ready separation of the cells, as well as by the presence of bundles of vessels of the dotted or intempled spiral kind. The substance so generally employed to deepen the colour of coffee, Dr. Hassall found to consist, in those instances in which he had examined it, of burnt sugar; and he referred to the fact, that the rich brown hue of coffee is not peculiar to a decoction of that berry, but that almost all vegetable substances, when charred, yield a somewhat similar colour. The author then proceeded to detail, in a tabular form, the results of 34 examinations of coffee of all prices. From these it appeared that the whole of the coffees, with two exceptions only, were adulterated; that chicory was present in 31 instances, roasted wheat in 12, colouring matter in 22, beans and potato flour in 1 only; that in 10 cases the adulteration consisted of but a simple article, in 12 of two, and in 10 of three substances; that in many instances the quantity of coffee present was very small, and in others not more than a fifth fourth, third, half, and so on.

Contrasting chicory and coffee, it was observed that while the coffee-berry contains a large quantity of essential oil, visible in small drops in the cells, and upon which the fragrance and the active properties mainly depend, not a trace of any similar oil is to be found in the chicory root. The properties of coffee are those of a stimulant and neurine tonic, with an agreeable flavour and delicious smell, in all which respects chicory is very greatly inferior. The adulteration

of coffee with wheat, bean, and potato, Dr. Hassall considers to be altogether indefensible, since these substances have not one of the properties of coffee belonging to them; and he observed that if the employment of chicory be deemed in any respect desirable, it should be sold openly, and not as at present surreptitiously, and under the names of Ceylon, Berbice, Costa Rica, and Mocha coffees, &c.

The paper contained many other interesting details, and was brought to a conclusion by one or two hints addressed to coffee drinkers,—viz., that the coffee should be ground fine, in order to facilitate the liberation of the essential oil contained in the cells of the berry, and that an infusion and not a decoction of it should be made.

AIR-WHISTLE.

Mr. C. Daboll, of New London, Connecticut, has invented a Whistle for the use of vessels at sea or on coasts where dense fogs prevail, and ships are liable to come into collision before they are conscious of each other's approach. Its great advantage is its power of communicating sounds for a distance of from four to five miles, far exceeding the largest bells. An experimental whistle was placed on Bartlett's Reef, and the pilot of the "Lawrence" states that he has heard it when about four miles off from Bartlett's Reef, *against the wind*, which was blowing quite fresh at the time. This was on a clear day, and when the whistle was blown at his request, and also by advice of the inventor, so that the distance might be marked. It is probable that, under the same circumstances, the tones of a bell could not have been heard more than from one half to three-fourths of a mile. The pilot of the steamer "Knickerbocker" reports, that he *made the whistle* during a dense fog, thirteen minutes' running-time of the steamer, before coming up with the station where it is located. He therefore must have been some four or five miles distant from it when he heard it.

This whistle consists of an air-chamber or condenser, of boiler iron, sufficiently strong to resist almost any pressure, an air-pump, and a whistle similar to the ordinary ones used on locomotives. By means of the air-pump operating into this chamber, a pressure of air is obtained upon it of any required amount,—say one, two, or three hundred pounds to the square inch. When the air is so compressed, it is made to operate on the whistle by simply opening a valve, when it gives a distinct clear sound.

USE OF PARACHUTES IN MINES.

It is well known that vertical ladders for descending into deep mines are very fatiguing, so that the miners prefer to trust themselves to baskets suspended by ropes,—and in many cases the baskets are the only means provided for descending and ascending. But accidents frequently occur from the breaking of the ropes, in spite of all the precautions that can be taken to prevent it. The *Brussels Herald* states that some experiments have lately been made on a

large scale, in Belgium, with a contrivance intended to remedy this evil. The basket or cuffert is so made, that, in case the rope breaks, it immediately springs open, forming a sort of Parachute, which is held suspended in the air by means of the strong current which, it is well known, is always rushing up from mines, owing to the temperature below being higher than that above. The effect of this apparatus has been shown before a numerous company, several miners entrusting themselves to the basket, which was so arranged that at a certain point the rope broke: they were sustained in the air by the open basket, so that the experiments were entirely satisfactory.

NEW GAS STOVE.

Mr. W. C. Ward has described to the British Association this invention, the novelty of which consists in constructing the stove in a vertical position, so as to expose considerable surfaces for the absorption of heat from Gas-burners, and for the radiation of such heat. The author finds that his apparatus is sufficient to raise the temperature of a moderate-sized room from five to ten degrees of Fahrenheit, with a consumption of about three feet of gas per hour, costing about 2*d.* for ten hours; that it is particularly useful in warming a bed-room, where only a slight elevation of temperature is required; and that it is free from the production of dirt or smell. —*Athenæum*, No. 1176.

DOMESTIC GAS GENERATOR.

Mr. James Webster, Leicester, engineer, has patented certain apparatus for the manufacture of coal or resin-gas, which he terms "a Domestic Gas Generator."

1. This "generator," when coal is used, consists of three retorts, supported in a suitable setting, two of which are charged with coal in the usual way, with the exception of a portion of the length near the end of each, which is separated from the rest by a perforated plate, and filled with pieces of iron and black lead in powder. In the upper part of the setting there is a boiler, in which steam is generated at a pressure a little above that of the atmosphere. The steam is conducted by pipes into the small end chambers, and carries thence the black lead into the retorts, depositing it upon their interior surfaces, and thereby preventing their being deteriorated by its action. The three retorts and boiler are heated by one furnace. The gaseous products and steam escape from these two retorts into the third, where such portions as have not been transformed into gas are completely evolved; after which they pass into a condenser, where the steam is condensed, and the gas escapes to the gasometer.

2. The "generator" for resin-gas is very similar to the preceding, with the exception that the third retort is filled with pieces of iron and black lead in powder, into which steam is admitted from the boiler, passing thence into the other two retorts that are supplied with melted resin from a reservoir in the upper part of the setting.

The steam and gas then pass to a condenser, where the former is condensed, after which the latter escapes to a gasometer.

COOKING BY GAS.

At the great dinner of the Royal Agricultural Society, on July 17 last, at Exeter, provided by M. Soyer, the baron with saddle-back of beef *à la* Magna Charta, weighing 535 lbs., particularly attracted attention. This joint was perfectly novel, being the whole length of the bullock, including the rumps, rounds, loins, ribs, and shoulders, to the neck; being the largest joint ever cooked. M. Soyer having promised it should be roasted in the open air, a large number of persons were present, anticipating that they would see a large fire; but, to their great surprise, they saw nothing but a few bricks, without mortar, and a few sheets of iron, forming a temporary covering to a space of six feet six inches in length, and three feet three inches in width; the monster joint frizzling and steaming away, with a heat from 216 very small jets of gas coming through pipes half an inch in diameter. In five hours the beef, for less than five shillings, was thoroughly dressed. On its arrival at the pavilion, it was deposited under the grand triumphal trophy, designed and erected by M. Soyer, in the form of an arch, seventeen feet high and ten feet wide; and composed of one swan, two turkeys, four geese, four ducks, eight fowls, eight pigeons, four rabbits, one fine barn-door cock, six ox heads, four calves' ditto, two rams' ditto, two stags' ditto, two whole lambs, all natural in their plumage or skin, ornamented with vegetables, fruit, and flowers—viz. cabbages, turnips, potatoes, carrots, leeks, celery, rhubarb, onions, French beans, peas, asparagus, and sea-kale stalks, with sheaves of wheat, oats, and barley, ornamented with pine apples, citrons, cherries, grapes, melons, peaches, apricots, greengages, apples, gooseberries, strawberries, currants, and the choicest kinds of flowers, all being the production of the county, surmounted by various implements of agriculture. There was also an elegant jug, ornamented with flowers, filled with clotted cream. On the top of the huge piece of beef was placed a black pig's head, weighing 80 lbs. when killed.

ESSENCE OF MILK.

Mr. Moore, an extensive farmer in Staffordshire, has, under a license from the patentee of the new process of concentrating milk, fitted up an apparatus by which he manufactures annually the produce of about thirty cows. The milk, as it is brought from the dairy, is placed on a long shallow copper pan, heated beneath by steam to a temperature of about 110°. A proportion of sugar is mixed with the milk, which is kept in constant motion by persons who walk slowly round the pan, stirring its contents with a flat piece of wood. This is continued for about four hours, during which the milk is reduced to a fourth of its original bulk, the other three-fourths having been carried off by evaporation. In this state of consistency it is put into small tin cases, the covers of which are

then soldered on, and the cases and their contents are placed in a frame which is lowered into boiling water. In this they remain a certain time, and after being taken out and duly labelled, the process is complete. The milk thus prepared keeps for a lengthened period. It supplies fresh milk every morning on board ship, and may be sent all over the world in this portable form.—*Mechanics' Magazine*, No. 1415.

LORKIN'S PATENT EGG-BEATER.

THIS useful kitchen implement is a cylindrical vessel, formed of wood, earthenware, metal, or other suitable material, to the inner surface of which there are affixed three rows of projecting pins or beaters, five in each row, which are so placed in relation to one another that those of each row come opposite to the intermediate spaces between the beaters of the opposite row. The lid has two projections, which take into a groove formed in the tip of the vessel. When the lid is put on, the projections are inserted into the openings, through which they gain admission into the groove; whereupon, by turning the lid a little round, it becomes securely and closely fixed in its place. The portions of the egg or other substance to be "beat up" being put into the vessel, and the lid put on as above described, the vessel is then taken in the hand, and shaken to and fro with such a degree of force, as to cause the contents to be driven successively against the top and bottom and sides of the vessel, during which operation the beaters break up and comminute the materials, and cause them to assume the triturated and frothy state desired.

In one of the other varieties described, the cylindrical vessel is fitted inside with two diaphragms of wire gauze, the wires of which produce the same breaking up or triturating action as is effected by the projecting pins or bearers.

There is also another form specially for breaking large quantities of eggs at a time.

OIL OF TURPENTINE AN ANTIDOTE TO MOTHS.

SHREDS of Russia leather are often put amongst garments when not in use to preserve them from moths; so is camphor; but neither of these seem so effectual as common Oil of Turpentine.

A simple way of using oil of turpentine, for the protection of woollens and furs, is to saturate bits of flannel with the oil, and to wrap them up separately in clean woollen, linen, or cotton cloth, to prevent the oil from penetrating to the outside of the wrappers, and injuring the articles around them. Six or seven pieces of thick flannel, each about a quarter of a yard square, are sufficient for a trunk 4 feet long by 18 inches broad and deep; a layer of the garments to be protected should be first placed in the trunk, upon it two pieces of the prepared flannel, then a layer of garments, and so on a layer of garments, and a piece or two of the prepared flannel, till the trunk is about half full; above which may be filled in with garments

alone. The lid of the trunk should then be immediately shut down, to prevent escape of the oil by evaporation.

Cloths have thus been perfectly protected in the same room where a Cashmere shawl, carefully wrapped up with camphor, became much moth-eaten.

Should there be occasion to open such a trunk, the oil of turpentine should be renewed; otherwise the quantity above indicated is sufficient for the protection of articles within a close shutting trunk for five or six months.—*Mechanics' Magazine*, No. 1396.

TO REMOVE THE STAIN OF PORT WINE FROM MARBLE.

We are not aware of any nostrum to be applied to the surface of white or veined marble that will extract port wine or other vegetable stains. We give a plan recommended by Mr. C. H. Smith, but this can only be put in practice by a mason or other person having convenient premises and implements. Suppose the article stained to be a slab, such as the shaft of a chimney-piece or top of a table; the only successful mode of procedure is to open the pores of the marble by rubbing it on both sides with sand and water, so as completely to remove the polish; then lay it, exposed to wind, rain, and all atmospheric influences, in a bed of clean, wet sand, from a quarter to half an inch thick, the sand to surround the marble up to its thickness, so as to be level with the upper surface: thus situated, the marble and sand should be sluiced with clean water two or three times a day, until the stains have quite disappeared, which probably will occupy ten or fifteen days; the marble is then to be repolished in the usual manner. White marble is so very delicate, and so easily stained, that great care is requisite in the above process that the article on which the sand is laid will not impart an additional stain: the best material is new stone of any kind, or new deal boards.—*Builder*, No. 409.

TERRA COTTA DECORATIONS.

Messrs. Bowers and Baddeley, of Tunstall, Staffordshire potteries, have produced some architectural Decorations made from a combination of Staffordshire clays. The clay when properly mixed is subjected to great pressure, in order to drive out the fixed air: having undergone this process, the clay is moulded and baked in the usual mode of baking earthenware. From the great pressure employed in the process of preparing the clay and in moulding it, as well as from the effect of certain ingredients employed in the process, the clay after having been baked assumes a perfectly vitreous character, and loses its absorbent properties. Bricks and ornaments of all kinds thus formed are impervious to wet, while from their non-absorbent qualities they may easily be painted. In work of this description the difficulty is to prevent warping and obtain straight lines. The patentees, however, speak with confidence of their ability in this respect.

WATERPROOFING FLEECES OF SHEEP.

Mr. Smith, of Deanston, has made an important discovery in the treatment of the Fleeces of Sheep, whereby the fleece of the living animal is rendered repellent of water bya simple and cheap process; so that the sheep are defended from the pernicious effect of wet, whilst the natural emanations from the body remain unchecked, and the growth and quality of the wool are improved. The effect of this water-proofing has been practically tested on some of the most exposed sheepwalks in Scotland, and with singular success. This process, it is expected, will effectually supersede the laying with tar and butter, and other salves, at one-third of the cost, whilst the wool will be preserved white and pure. Though the laying or salving of sheep hitherto has been applied chiefly to flocks on mountainous and exposed situations only, it is believed that the new mode of treatment will be found beneficial to flocks on the most sheltered and southern pastures; and that it will go far to prevent or mitigate that destructive disease, the rot, which is neither more nor less than dysentery, caused by the continuance of wet weather, whereby the fleeces of the sheep become soaked with rain, and produce the same effect as is produced on man by wet clothing. It is also presumed that this mode of treatment will lead to the successful introduction of the Spanish sheep and the alpaca, which are known to have suffered from the prevalence of wet weather in this country.—*Times.*

A NEW OVEN.

Mr. M. Fitch has invented an Oven, the furnace of which is a circular fire cylinder of $8\frac{1}{2}$ inches diameter; the fire divides at the lower end right and left into two cylinders of 6 inches diameter, and the heat ascends at each angle of the front of the oven, and enters two deflectors, which it traverses backwards and forwards, so as to secure equal heat all over the oven. Beneath the furnace is another oven for cooking joints. A bushel of bread and four shoulders of mutton have by this new oven been cooked at an expenditure of $8\frac{1}{2}$ lbs. of coals, which is a fraction less than 1d.: after the heat is thus got up, the same could be done for $\frac{1}{2}$d., and the oven kept in operation all day for about $3\frac{1}{2}$d. or 4d.—*Chelmsford Chronicle.*

BREAD-MAKING MACHINERY.

Messrs. Robinson and Lee, of Long Melford, Suffolk, and Glasgow, have patented certain improvements in the manufacture of Bread, and in the Machinery and Apparatus to be used therein; and also improvements in the regulation of ovens and furnaces, part of which improvements are also applicable to other similar useful purposes.

The patentees describe and claim,

1. The application of carbonated or aërated waters in the manufacture of bread.

2. A peculiar construction of machine which mixes the flour, kneads the dough, and cuts and moulds it into shape.

3. The baking of bread and biscuits, roasting coffee, &c., &c., by applying surcharged steam, and the use of a pyrometer or heat regulator, which consists of a bar of metal, one end abutting against a lever in connection with a throttle-valve in the steam supply pipe, which as it expands by the increased temperature of the oven or furnace, will have the effect of diminishing the supply of surcharged steam thereto.

THE VENTILATING BRICK.

A NEW registered Brick, denominated "the universal Ventilating Brick," appears to be deserving the attention of architects and other persons employed in the erection of buildings. The objects sought to be attained by the use of the brick are—first, a thorough draught throughout the walls of the building, so as to ensure perfect dryness of the walls, and complete security against the dry rot; secondly, the easy and economical diffusion of artificial heat in hothouses and other buildings of that description; and thirdly, a saving in the cost of the brickwork itself to the extent of upwards of 30 per cent. The brick is also stated to be particularly well adapted for paving kitchens, lobbies, &c.; as it admits of a free current of air under the flooring, and ensures perfect freedom from damp,—and in the case of new buildings, by the application of artificial heat, the walls may be dried, and the building rendered habitable, within an exceedingly short space of time.—*Daily News.*

TO RESTORE DECAYED IVORY.

DR. LAYARD, in his explorations among the ruins of Nineveh, discovered some splendid works of art carved in Ivory, which he forwarded to England. When they arrived there, it was discovered that the ivory was crumbling to pieces very rapidly. Professor Owen was consulted to know if there was any means of preventing the entire loss of these specimens of ancient art: he came to the conclusion that the decay was owing to the loss of the albumen in the ivory, and therefore recommended that the articles be boiled in a solution of albumen. The experiment was tried, with complete success, and the ivory has been rendered as firm and solid as when it was first entombed.

There are several sorts of ivory, differing from each other in composition, durability, external appearance, and value. The principal sources from which ivory is derived are the western coast of Africa and Hindostan: Camaroo ivory is considered the best, on account of its colour and transparency. In some of the best tusks the transparency can be discovered even on the outside. The manufacturers have a process by which they make poor ivory transparent, but it lasts only a short time. A third kind of ivory, called the Egyptian, has lately been introduced, which is considerably lower in price than the Indian, but in working there is much waste. By an analysis, the African ivory shows a proportion of animal to earthy matter of 101 to 100; the Indian, 76 to 100; and the Egyptian,

70 to 100. The value of ivory consumed in Sheffield, where it is much used in making handles for cutlery, is very great, and nearly 500 persons are employed in working it up. To make up the weight of 180 tons consumed in that place, there must be about 45,000 tusks, whose average weight is 9 pounds each, though some weigh from 60 to 100 pounds. According to this, the number of elephants killed every year is 22,500; but, allowing that some tusks are cast, and some animals die, it may be fairly estimated that 18,000 are killed every year merely for their ivory, which is contrary to the usual belief that the ivory used comes from the tusks cast by living elephants. These estimates, it will be seen, are for Sheffield merely.—*Jameson's Journal*, No. 97.

FLEXIBLE IVORY.

M. Charriere, a manufacturer of surgical instruments in Paris, has for some time been in the habit of rendering flexible the Ivory which he uses in making tubes, probes, and other instruments. He avails himself of a fact which has long been known: that when bones are subjected to the action of hydrochloric acid, the phosphate of lime, which forms one of their component parts, is extracted, and thus bones retain their original form and acquire great flexibility. M. Charriere, after giving to the pieces of ivory the required form and polish, steeps them in acid alone, or in acid partially diluted with water, and they thus become supple, flexible, elastic, and of a slightly yellowish colour. In the course of drying, the ivory becomes hard and inflexible again; but its flexibility can be at once restored by wetting it either by surrounding it with a piece of wet linen, or by placing sponge in the cavities of the pieces. Some pieces of ivory have been kept in a flexible state in the acidulated water for a week, when they were neither changed, nor injured, nor too much softened, nor had they acquired any taste or disagreeable smell.—*Jameson's Journal*, No. 97.

PROCESS OF ENGRAVING UPON IVORY.

The process used to cover ivory with ornaments and designs in black consists in Engraving in the Ivory itself, and then filling in the designs with a black hard varnish.

To obtain finer and more regular designs, the ivory is to be covered with the common ground, and by means of the point the designs are engraved upon it. They are then eaten in by a solution formed as follows:—

Fine silver..................	6	grammes.
Nitric acid	30	,,
Distilled water	125	,,

At the end of about half an hour, according to the depth to be given, it is to be washed with distilled water, and dried with bibulous paper. The design is then exposed for an hour to the solar light, and the layer of wax is removed by essence of turpentine.

The design has then a black colour or a dark brown, which blackens entirely at the end of one or two days. Other colours may be produced, by replacing the solution of nitrate of silver by a solution of gold or platina in aqua regia, or of copper in nitric acid.—*Révue Scientifique*, xxxv. p. 433.

FRENCH PATENT FOR WORKING AND MODELLING IN PLASTIC IVORY, ETC.

MADAME ROUVIER'S process is as follows:—Take the waste turnings of Ivory, bone, horn, &c., and steep them in a vessel containing a weak acid solution. Nearly all the acids will serve for this purpose, but the following are preferable:—muriatic, nitric, tartaric, acetic, citric, and oxalic, also phosphate of lime. The solution is placed in a water bath, at a temperature of 35° to 40° C. (95° to 104° Fahr.), in order to obtain complete liquefaction. It is then passed through fine muslin, and about one-fourth the quantity of ivory gelatine is next added, to absorb the solvent. When the paste is well prepared, the excess of liquid, and any foreign gases, are removed by means of an air-pump: it thus becomes homogeneous, membranous, and very close. In this state it would be difficult to run it for use; for which purpose it must be dissolved in copal or lac varnish, and in this state it may be run into moulds. When the paste is in the moulds, it may be made to undergo pressure, to expel the air and prevent the formation of air-bubbles in the interior. Colouring matters may be added to the paste.

THE GUTTA PERCHA TRADE.

PREVIOUS to 1844, the very name of Gutta Percha was unknown to European commerce. In that year, 2 cwt. of it were shipped experimentally from Singapore. The exportation of gutta percha from that port rose in 1845 to 169 piculs (the picul is 133⅓ lbs.); in 1846, to 5,364; in 1847, to 9,296; in the first seven months of 1848, to 6,768 piculs. In the first four and a half years of the trade, 21,598 piculs of gutta percha, valued at 274,190 dollars, were shipped at Singapore; the whole of which was sent to England, with the exception of 15 piculs to Mauritius, 470 to the continent of Europe, and 922 to the United States.

But this rapid growth of the new trade conveys only a faint idea of the commotion it created among the native inhabitants of the Indian Archipelago. The jungles of the Johore were the scene of the earliest gatherings, and they were soon ransacked in every direction by parties of Malays and Chinese, while the indigenous population gave themselves up to the search with an unanimity and zeal only to be equalled by that which made railway jobbers of every man, woman, and child in England about the same time. The Tamungong, with the usual policy of oriental governors, declared the precious gum a government monopoly. He appropriated the greater part of the profits, and still left the Malays enough to stimulate them to pursue the quest, and to gain from 100 to 400 per cent. for

themselves on what they procured from the aborigines. The Tamungong, not satisfied with buying at his own price all that was collected by private enterprise, sent out numerous parties of from 10 to 100 persons, and employed whole tribes of hereditary serfs in the quest of gutta percha.

This organised body of gum-hunters spread itself over the whole of Johore, peninsular and insular. They crossed the frontier into Ligna, but there the Sultan was not long in discovering the new value that had been conferred upon his jungles. He confiscated the greater part of what had been collected by the interlopers, and in emulation of the Tamungong declared gutta percha a royalty.

The knowledge of the article stirring the avidity of gatherers, gradually spread from Singapore, northward as far as Pinang, southward along the east coast of Sumatra to Java, eastward to Borneo, where it was found at Brunė, Sarawak, and Pontianak on the west coast, at Keti and Passir on the east. The imports of gutta percha into Singapore from the 1st of January to the 12th of July, 1848, according to their geographical distribution, were:—From the Malay Peninsula, 593 piculs; from the Johore Archipelago, 1,269; from Sumatra, 1,066; from Batavia, 19; from Borneo, 55. The price at Singapore was originally 8 dollars per picul: it rose to 24, and fell about the middle of 1848 to 13.

In the course of three and a half years 270,000 trees were felled, in order to get at the gum.—*Daily News*, Sept.

It is well known that his Grace the Duke of Devonshire is unfortunately afflicted with deafness. As an experiment, the Gutta Percha Company in the City Road fitted up tubes in Lismore Cathedral for the accommodation of his Grace, whose pew is between 30 and 40 feet from the pulpit, and the trial has been perfectly successful, as the Duke declares he can now hear most distinctly every word uttered by the clergyman. The hearing apparatus for churches manufactured by this Company is most singular. The part where the sound enters is about a foot broad, of an oval shape, somewhat resembling the outline of a well-formed ear. This, when placed against the front of a pulpit, is suitably ornamented, and has all the appearance of elaborate wood-carving, but it may be hidden by the pulpit covering, be erected within the pulpit, at its sides, or even behind the preacher. No particular elevation of the voice is necessary for its complete application. The pipe from this receiver is conducted out of sight, underneath the flooring, or in any manner convenient, to the desired part of the edifice. If necessary, however, small pipes may branch off from the main one, and thus half a dozen or more persons derive the benefit in a most perfect manner, and unobserved; the effect being the same as if the orator were speaking near the ear of a person having the sense of hearing unimpaired.

NEW METHOD OF ENGRAVING PLATES FOR PRINTING FERNS, SEA-WEEDS, ETC.

Dr. Branson has described to the Sheffield Literary and Philosophical Society this process. His mode of operation is to place a frond of fern, algæ, or similar flat vegetable form, on a thick piece of glass or polished marble; then taking and softening a piece of gutta percha, of proper size, and placing on the leaf and pressing it carefully down, it will receive a sharp and accurate impression from the plant. The gutta percha retained level, and allowed to harden by cooling, is then handed to a brass caster, who reproduces it in metal from his moulding vase. This, it will be obvious, is the most delicate and difficult part of the process. Dr. Branson has had many brass plates thus produced from sand-casting, which only required a little surface-dressing to yield at once, under the copperplate printing press, most beautiful as well as faithful impressions of the original leaves: indeed, many of the exhibited specimens of ferns, printed in green colour, and slightly embossed, as they must needs be by the printing, were such perfect fac-similes of the natural pattern, that they might easily be taken for it. Besides these matters, the Doctor exhibited a large variety of patterns of embossed leather, which had been produced by a somewhat analogous operation. As, however, this latter invention is not so much for copying designs as for creating them, and, at the same time, saving all the expense of die-cutting, the following is the course pursued:—The operator takes a piece of common hard white soap of the required size and surface, and upon that executes any design, whether of the depth and boldness of ordinary embossing, or in the delicate lines of an etching: in either case the work is executed with the greatest ease. From this soap-model or engraving an impression is taken in gutta percha; from *that* a secondary one, which, on being cast in brass, as before, may be used for printing or embossing in the ordinary way. The Doctor stated that his main difficulty was in getting the last gutta percha coat to separate from the mould of the same substance into which it was pressed. He had found, however, that by powdering both the surfaces with common bronze dust, before taking the impression, they did not adhere.—*Sheffield Times.*

WHITE ZINC.

Mr. E. Protheroe, of Austinfriars, has patented certain improvements in the manufacture of Zinc Oxide for Paint. He claims, amongst others, an arrangement of apparatus, consisting of a reverberatory furnace, in which the zinc is melted, and two retorts, in communication with each other, into which the metal flows; so that a constant clean surface of melted zinc is kept submitted to the action of currents of atmospheric air. The lighter portions of the oxide pass up a shaft, and, by a current of steam, to the condensing chambers; the air passing off through suitable chimneys. Bleaching the light oxide by means of water acidulated

with sulphuric or acetic acid, and combining the same, to facilitate its drying, with umber, dissolved in muriatic acid over a fire, concentrated to the consistence of butter or honey, and mixed with resin, are also amongst his claims.

PAPERING ON DAMP WALLS.

A PATENT has been taken out for a fluid, containing chiefly India-rubber and gutta percha (dissolved, we presume, in turpentine or naphtha, with, it may be, a little boiled oil), for brushing into Damp Walls as a preparative to papering or painting. It dries into a waterproof film in a couple of days, and will then take on either oil paint or paste for paper. It may also be brushed on the papers themselves, and form waterproof papers. In painting new woodwork, according to the *Patent Journal*, this preparation prevents subsequent shrinking, swelling, or cracking, and obviates the necessity of priming for knots, when used as a first coat, or mixed with paint.

PORTABLE CRANE SHOWER-BATH.

THIS useful apparatus, invented by Mr. Thomas Loseby, 44, Gerrard Street, Islington, consists of the three standards or supports, one of which is prolonged beyond the others, and carries a cross head with two pulleys centred in it, and over which a cord passes, having suspended from one of its ends the shower-bath; while the other end is attached on, by means of an iron handle, to a hook: one end of a rod is hinged, and from the other is suspended the curtain, which is to be used for drying behind after the bath has been taken. Wire hoops retain the curtains in the circular form, and close them instead of strings. When the apparatus is no longer required, the cord is released from the hook, which allows of the bath being lowered and removed. The standards can then be folded together by raising the triangular line.

The bath is filled by letting it down and placing the handle on the top hook. The water is then poured in, when the handle is drawn down and placed on the bottom hook. In doing this, the cord should be kept within an inch or two of the leg to which it is attached.

The advantages of this construction are—1. its portability; the stand only weighing 9 lbs.; 2. the small space it occupies when closed; 3. the comfort of curtained space to dry in, so that warm water may be used during the winter months without the bather having to step at once into the cold room; and 4. the low cost at which it can be manufactured.

BURSTING OF WATER-PIPES.

MR. MACPHERSON has read to the British Association a communication on a method of preventing the Bursting of Water-pipes during frost. The only method he regarded as effectual was that of emptying the pipe. This he proposed to do by causing the expan-

sion consequent upon freezing to work a linn so as to shut the service-pipe and open the waste-pipe. Several members expressed their opinion as favourable to this improved method.

IMPROVEMENT IN EARTHENWARE PIPES, ETC.

A PATENT has been granted to Mr. B. A. Burton, of Holland Street, Southwark, for Improvements in the Manufacture of Pipes, tiles, bricks, stairs, copings, and other articles required for building purposes. The process hitherto adopted in the manufacture of pipes from plastic materials consists of forcing the clay through a die, so as to form the pipe, and afterwards baking the pipe in an oven. In addition to this process, Mr. Burton proposes, after the pipes have been formed, and whilst in a plastic state, to subject them to a certain amount of pressure, by passing them between rollers, whereby it is said that pipes, after they have undergone this process of compression, are not only stronger, and consequently more durable, but also more regular in their structure, and smoother; so that they will offer less resistance to the passage of fluids, and will also be less liable to the accumulation of deposit. The clay having been forced through the die in the form of a pipe, slips over a mandrill, attached to the centre part of the die; the lower end of the mandrill being made to project a little beyond the centre line of four rollers, all moving in the same direction, and with the same surface velocity, so that the clay pipe is drawn between the rollers, and over the end of the mandrill, whereby the particles of matter become compressed or consolidated to such an extent, we are told, that, when baked, they have been found, by repeated experiments, to be upwards of 75 per cent. stronger than pipes manufactured in the ordinary way. In the case of a stairs tread, the rollers forming the front and top of the step may be engraved so as to form an ornamental step. The inventor states, that by the application of the eccentric or convolute rollers, a great variety of articles applicable to building purposes may be moulded and compressed as above described. In addition to the above, the specification describes a mode of making bends for pipes; also a variety of machines for cutting socket or rebate and screw joints upon the ends of pipes.—*Builder*, No. 361.

SPONGE TRADE OF THE BAHAMAS.

"SPONGING" within the Bahamas is stated to have increased almost incredibly since the year 1847. From Bay Street to Thompson's Folly, vast quantities of sponge may be seen covering fences, yards, and house-tops, where it is left to dry, after having been previously buried (in order to kill the zoophyte which inhabits it), and washed. It is afterwards divested of the fragments of rock which adhere to it, pressed, and packed in bales, averaging 300 lb. weight each, for the London market, where it is manufactured into cloth, hats, &c., and converted to many useful purposes. We are informed that it has recently become the medium for applying

poultices to wounds, instead of cloth. The following statistics are from a gentleman engaged in shipping large quantities :—From the 1st of January to 30th June of the present year there were exported nearly 1,000 bales of sponge, of the value at least of 25 dollars each—25,000 dollars ; on the 1st of January a very small stock of sponge was on hand, while on the 30th of June every dealer in this article had a large stock ; therefore, as it is a cash article, there must have been paid to the crews employed in this trade at least 40,000 dollars.—*Nassau (N.P.) Guardian*, August 17.

PATENT SWIMMING STOCKINGS.

THE object of this apparatus (the invention of Mr. Cox, Georgie Mills, Edrie, N.B.) is to enable a person, in case of emergency, to swim or propel himself through the water with the facility of the swan, duck, or other aquatic webbed-feet birds or animals; and thereby to possess the means of saving not only his own life, but the lives of others.

The Swimming Stockings present various advantages, being light, portable, easy of application, and can even be worn on the legs without incumbrance, and thus be ready for use in the moment of need.

The swimming apparatus consists of a circular piece of suitable cloth, sewed strongly round the leg of a stocking, and kept in a proper position for expanding and contracting by means of cords and wooden ribs ; it resembles, in fact, a small umbrella round the leg ; expanding when pushed against the water, and closing when drawn in an opposite direction. In using it the stockings are to be drawn on the legs quietly and tightly, and fastened with an elastic garter below the knee, to prevent them from slipping down.

To make the most rapid progress through the wâter, the best position is on the back. The swimmer ought to draw well up, and strike smartly out, each leg *alternately*, in the line of motion of the body, for by doing so a more continuous and uniform motion is kept up than when both legs are drawn up and struck out together. The leg ought to be held steady for an instant after being drawn up, as the rush of water after it assists the expansion of the apparatus previous to taking the out stroke, which consequently is more effective from the "slip" being less. For a *prolonged swim*, an average of from fifty to sixty strokes per minute will be found very suitable in point of speed and economy of strength ; but a little experience on the part of the swimmer will soon make him acquainted with the best ways of using the stockings. The expansion of the cloth round the stockings will occupy a diameter of from 12 to 16 inches, which affords about a square foot of propelling surface. With a pair of these stockings a person may swim in summer weather a mile for pleasure, and several miles if for his life.—Abridged from the *Mechanics' Magazine*, No. 413.

CUTTING OUT GARMENTS.

MR. THOMAS DAWSON, Milton Street, Euston Square, machinist, has patented certain improvements in cutting and shaping Garment

and other articles of dress for the human body. The patentee employs a machine to cut several pieces of cloth at the same time, somewhat similar to what has already been used to cut gloves, with the exception that the position of the cutters may be varied so as to produce different shapes. This machine consists of a top plate perforated with numerous holes, in which are held, by screw-nuts, a number of standards. These standards have collars that bear against the under part of the perforated plate, and are thereby prevented sliding up. The cutters, some of which are hinged and the rest capable of sliding one over the other, are held in the lower part of the standards, and are retained in position with regard to one another by screws. The machine is placed in a screw press, and the layers of cloth put under the blades or cutters, which, when forced down by the application of pressure, will divide them into the required shapes. When fustians are to be cut, it is proposed to make the edges of the cutters serrated.

PORPOISE LEATHER AND OIL.

Some Leather tanned from the skin of the white Porpoise, specimens of which were exhibited at the late Quebec mechanical fair, attracted general attention. The strength and the beautiful finish of the leather were much admired: it is equal in the latter respect to the finest calf skin, and in the former quality is much superior. Porpoises are to be found in great numbers on the banks of the St. Lawrence, and a most profitable business might be carried on in capturing them: not only the skin, but the oil which they contain, being very valuable. The specimens sent to Montreal were bought up immediately, and an order given by the Trinity House for a quantity of the oil. The exhibitor, Mr. Tetu, was awarded a premium of £10.—*Quebec Gazette.*

APPLICATION OF ELECTRO-MAGNETISM AS A MOTIVE POWER. BY MR. ROBERT HUNT.

In this paper, (read to the Society of Arts, on May 22,) the author called attention, in the first place, to the numerous attempts which have been made to apply Electro-Magnetism as a power for moving machines, and particularly described the apparatus employed by Jacobi, Dal Negro, M'Gauley, Wheatstone, and others, noticing incidentally the machines recently constructed by Mr. Hjorth. Since, notwithstanding the talent which has been devoted to this interesting subject, and the large amount of money which has been spent in the construction of machines, the public are not in possession of any electro-magnetic machine which is capable of exerting any power economically; and finding that, notwithstanding the aid given to Jacobi by the Russian Government, that able experimentalist has abandoned his experimental trials,—the author has been induced to devote much attention to the examination of the first principles by which the power is regulated, with the hope of being enabled to set the entire question on a satisfactory basis.

The phenomenon of electro-magnetic induction was explained, and illustrations given of the magnetisation of soft iron by means of a voltaic current made to circle around it. The power of electro-magnets was given, and the author stated his belief that this power could be increased without limitation.

A voltaic current produced by the chemical disturbance of the elements of any battery, no matter what its form may be, is capable of producing by induction a magnetic force, *this magnetic force being always in an exact ratio to the amount of matter (zinc, iron, or otherwise) consumed in the battery.*

Several forms of the voltaic battery were explained, particularly those of Daniell, Grove, Bunsen, and Reinsch; the latter being constructed without metals, depending entirely on the action between two dissimilar fluids, slowly combining.

The author had, however, proved, by an extensive series of experiments, that the greatest amount of magnetic power is produced when the chemical action is the most rapid. Hence, in all magnetic machines, it is more economical to employ a battery under an intense action, than one in which the chemical action is slow. It has been proved by Mr. Joule, and most satisfactorily confirmed by the author, that one-horse power is obtainable in an electro-magnetic engine, the most favourably constructed to prevent loss of power, at the cost of 45 pounds of zinc, in a Grove's battery, in 24 hours; while 75 pounds are consumed in the same time to produce the same power in a battery of Daniell's construction. The cause of this was referred to the necessity of producing a high degree of excitement to overcome the resistance which the molecular forces offer to the electrical perturbations, on which the magnetic force depends.

It was contended that, although we have not perhaps arrived at the best form of voltaic battery, yet that we have learned sufficient of the law of electro-magnetic forces to declare that, under any conditions, the amount of magnetic power would depend on the change of state—consumption of an element—in the battery, and that the question resolved itself into this:—

What amount of magnetic power can be obtained from an equivalent of any material consumed?

The following were regarded as the most satisfactory results yet obtained:—

1. The force of voltaic current being equal to 678, the number of grains of zinc destroyed per hour was 151, which raised 9000 pounds one foot high in that time.

2. The force of current being, relatively, 1300, the zinc destroyed in an hour was 291 grains, which raised 10,030 pounds through the space of one foot.

3. The force being 1000, the zinc consumed was 223 grains: the weight lifted one foot 12,672 pounds.

The estimations made by Messrs. Scoresby and Joule, and the results obtained by Oersted, and more recently by Mr. Hunt, very nearly agree; and it was stated that one grain of coal consumed in

the furnace of a Cornish engine lifted 143 pounds one foot high, whereas one grain of zinc consumed in the battery lifted only 80 pounds. The cost of one hundredweight of coal is under 9 pence; the cost of one hundredweight of zinc is above 216 pence. Therefore, under the most perfect conditions, magnetic power must be nearly 25 times more expensive than steam power.

But the author proceeded to show that it was almost proved to be an impossibility ever to reach even this condition, owing, in the first place, to the rate with which the force diminishes through space. As the mean of a great many experiments on a large variety of magnets, of different forms and modes of construction, the following result was given:—

Magnet and armature in contact, lifting force			220	pounds.
„	distant $\frac{1}{250}$	of an inch	90·6	„
„	„ $\frac{1}{125}$	„	50·7	„
„	„ $\frac{1}{63}$	„	50·1	„
„	„ $\frac{1}{50}$	„	40·5	„

Thus, at one-fiftieth of an inch distance, four-fifths of the power are lost.

This great reduction of power takes place when the magnets are stationary.

The author then proceeded to show that the moment they were set in motion a great reduction of the original power took place; that, indeed, any disturbance produced near the poles of a magnet diminished, during the continuance of the motion, its attractive force.

The attractive force of a magnet being 150 pounds when free of disturbance, fell to one-half, by occasioning an armature to revolve near its poles.

Therefore, when a system of magnets which had been constructed to produce a given power is set in revolution, every magnet at once suffers an immense loss of power, and consequently their combined action falls in practice very far short of their estimated power. This fact has not been before distinctly stated, although the author is informed that Jacobi observed it.

And not merely does each magnet thus sustain an actual loss of power, but the power thus lost is converted into a new form of force, or rather becomes a current of electricity, acting in opposition to the primary current by which the magnetism is induced.

From an examination of all these results, Mr. Hunt is disposed to regard electro-magnetic power as impracticable on account of its cost, which must necessarily be, he conceives, under the best conditions, 50 times more expensive than steam power.

The Chairman (Mr. W. F. Cooke) agreed with Mr. Hunt in his conclusion of the improbability of any result being obtained from electro-magnetism which could enable it to compete with steam as a motive power. At any rate, the point to which the attention of engineers and experimentalists should be turned at present was, not the contriving of perfect machines for applying electro-magnetic

power, but the discovery of the most effectual means of disengaging the power itself from the conditions in which it existed stored up in nature. Mr. Faraday assured us that in a single drop of water is contained as much electricity as is developed in a thunder-storm. The portion of this which we can liberate by any existing battery is very small; so small, that, as shown by Mr. Hunt's paper, its practical use cannot be profitable. The study of electro-chemistry, he thought, was a more promising field, and one from which might at a future time be developed a power which should supersede even steam.

Mr. Winkworth proposed, and Mr. Highton seconded, a vote of thanks to Mr. Hunt.

PROF. PAGE ON ELECTRO-MAGNETISM AS A MOTIVE POWER.

Professor Page, in his lectures delivered before the Smithsonian Institution, states that there is no longer any doubt of the application of this power as a substitute for steam. He exhibited the most imposing experiments ever witnessed in this branch of science. An immense bar of iron, weighing 160lb., was made to spring up by magnetic action, and to move rapidly up and down, dancing like a feather in the air, without any visible support. The force operating upon the bar he stated to average 300lb. through ten inches of its motion. He said he could raise this bar 100 feet as readily as ten inches, and he expected no difficulty in doing the same with a bar weighing one ton, or a hundred tons. He could make a pile-driver, or a forge hammer, with great simplicity, and could make an engine with a stroke of 6, 12, 20, or any number of feet. The most beautiful experiment was the loud sound and brilliant flash from the galvanic spark, when produced near a certain point in his great magnet. Each snap was as loud as a pistol, and when he produced the same spark at a little distance from this point it made no noise at all. This recent discovery is said to have a practical bearing upon the construction of an electro-magnetic engine. He then exhibited his engine of between four and five-horse power, operated by a battery contained within a space of three cubic feet. It looked very unlike a magnetic machine. It was a reciprocating engine of two feet stroke, and the whole engine and battery weighed about one ton. When the power was thrown on by the motion of a lever, the engine started off magnificently, making 114 strokes per minute; though, when it drove a circular saw, 10 inches in diameter, sawing up boards an inch and a quarter thick into laths, the engine made but about 80 strokes per minute. The force operating upon this great cylinder throughout the whole motion of two feet was stated to be 600lb. when the engine was moving very slowly: but he had not been able to ascertain what the force was when the engine was running at a working speed, though it was considerably less. The most important and interesting point, however, is the expense of the power. Professor Page stated that he had reduced the cost so far that it was less than steam under many and most conditions,

though not so low as the cheapest steam-engines. With all the imperfections of the engine, the consumption of 3lb. of zinc per day would produce one-horse power. The larger his engines, contrary to what has been known before, the greater the economy. Professor Page was himself surprised at the result. There were yet practical difficulties to be overcome, the battery has yet to be improved, and it remains yet to try the experiment on a grander scale—to make a power of 100-horse, or more.—*National Intelligencer* (American paper).

SOCIETY OF ARTS.

The Annual Distribution of the Rewards of the Society of Arts took place on July 22, at the House in John Street, Adelphi; Lord Colborne, the Vice-President, being in the chair, in the place of Prince Albert, whom the death of the Duke of Cambridge prevented from presiding. The Address of the Council exhibited the Society as in a more flourishing condition than it has been for years,—250 new members having joined during the past twelve months. The Exhibition of Ancient and Mediæval Art has, it was stated, been highly successful. That the articles and essays for which rewards were distributed were not on the present occasion equal in interest to those of last year, was explained by the fact that inventors and manufacturers are reserving themselves for the Great Exhibition of 1851. Before presenting the medals, two silver cups, executed by Messrs. Garrard, after the design of Mr. Maclise, were presented to Dr. Paris, President of the Royal College of Physicians, and Mr. J. S. M. Fonblanque,—the two cups being in place of a single one which, in accordance with the will of the late Dr. Swiney, was last year given to these gentlemen as joint authors of the best treatise on Medical Jurisprudence.—The medals were then distributed in the following order:—

In the Section of Trade and Manufactures: To Messrs. Rufford & Finch, for their Porcelain Bath in one piece,—the Gold Isis Medal.——*In the Section of Fine Arts and Manufactures:* To Messrs. Campbell, Harrison, & Lloyd, for their Figured Silks for Dresses,—Messrs. J. Crossly & Sons, for their Printed Carpets,—Messrs. E. Henry & Sons, for their Embroidered Garment Fabrics,—Messrs. Keith & Co., for their Silk Furniture Damasks,—Messrs. Lambert & Bury, for their Tamboured Lace,—Messrs. Reckless & Hickling, for their Machine-made Lace,—and Messrs. Swainson & Dennys, for their Sweet-Pea Chintz,—the Gold Isis Medal. To Messrs. G. Bacchus & Sons, for their Specimens of Table Glass,—Messrs. Cornell, Lyell, & Webster, for their Seven-inch Ribands,—Messrs. Keith, Shoobridge & Co., for their Printed Shawls,—J. Coulston, for his Damasks,—Miss Stanley, for her Norwich Hand-made Lace,—Messrs. Stone & Kemp, for their Silk Damasks,—T. W. Wallis, for his Specimens of Carving in Wood,—E. Webb, for his Horse-hair Damasks,—and Messrs. J. & W. Wilson, for their Carpets,—the Silver Medal. To Messrs. R. S. Cox & Co., for their Seven-inch Ribands,—and G. Cook, for his Specimens of Carving in Wood,—the Isis Silver Medal. To Mrs. Temple, for her Flowers in Wax Composition,—the Manager of the School of St. Clair, for Specimens of Knitting executed by the Children under her charge,—J. M. Levien, for his Introduction and Application of New Zealand Woods for Furniture,—and W. Potts, for his Ornamental Metal Work,—the Honorary Testimonial. ——*In the Section of Chemistry:* To Messrs. M'Nair & Co., for their Coating for Electric Telegraph Wires,—the Silver Medal.——

In the Section of Mechanics: To Henry Bessemere, for his Sugar-cane Press,—and C. W. Siemens, C. E., for his Regenerative Condenser,—the Gold Medal. To G. Eaton, for his Plan for preventing Oscillation in Locomotives,—and W. H. Smith, C.E., for his Flexible Breakwater and Lighthouses,—the Gold Isis Medal. To A. F. G. Claudet, for his Glass-cutting Machines,—T. Syson Cundy, for his Pyro-pneumatic Stove,—J. Imray, for his Investigation of the Action of the Crank,—D. M'Kenzie, for his Reader for Jacquard Looms,—W. Melvine, for his Aphonetic Clock,—W. Pole, for his Investigation of the Action of the Crank,—and C. J. Varley, for his Improved Air-pump,—the Silver Medal. To Francis F. Colegrave, for his Spring Saddle-girth,—the Silver Isis Medal. To Goodhue, Clinton, & Co.,—for their Method of Constructing Metallic Attachments to Mineral Substances,—J. E. M'Douall, for his Vibrating Archimedean Drill-stock,—and J. Veitch, M.D., R.N., for his Medico-Chirurgical Ambulance—the Honorary Testimonial.

The Council have materially altered the scheme of their Prize List for the ensuing session;—the intimate connexion of the Society of Arts with the Exhibition of the Works of Industry of All Nations in 1851 having appeared to them, as they say, to render altogether superfluous any attempt on the part of the Society to pursue its ordinary course for the encouragement of arts, manufactures, and commerce, by the offer of its usual prizes for the session of 1850 and 1851. Having, therefore, considered how they might most usefully apply that portion of the revenue of the Society to the particular circumstances of the year, the Council are of opinion that the most useful work they can undertake will be to encourage the production of philosophical treatises on the various departments of the Exhibition, which shall set forth the peculiar advantages to be derived from each to the arts, manufactures, and commerce of the country. They accordingly offer the large medal and twenty-five pounds for the best, and the Society's small medal and ten pounds for the second-best treatise on the objects exhibited in the section of raw materials and produce;—the same for the best and second-best treatises on the objects exhibited in the section of Machinery,—for treatises on the objects exhibited in the section of Manufactures,—and for treatises on the objects exhibited in the section of Fine Arts.

Each Treatise is to occupy, and not exceed, eighty pages of the size of the *Bridgewater Treatises.* The Society will also award its large medal and twenty-five guineas for the best general treatise on the Exhibition, treated commercially, politically, and statistically; and small medals for the best treatises on any special object or class of objects exhibited. The treatises for which rewards are given are to be the property of the Society; and if deemed suitable for publication, should the Council see fit, they will cause the same to be printed and published, and will award to the author the net amount of any profits which may arise from the publication after the payment of the expenses. The treatises are to be delivered at the Society's House on or before the 30th of June, 1851. The Council announce that they do not intend to confine the rewards of the Society to the subjects above named; though, for the reasons

given, they do not anticipate that communications of interest on other subjects will be submitted.—*Athenæum*, No. 1187.

ELECTRO-MAGNETIC PASSENGER INDEX.

Mr. C. Pownall has invented a register, or index, by which the passenger, planting his foot on the step to enter an omnibus, or clamber to the top of it, is sensible of rather agreeable elasticity in the step, and is thence raised to the desired seat. Underneath the omnibus, in a little box about nine inches square, secured with a Bramah lock, there is a small battery; the pressure of the passenger's foot upon the step moves a spring, and, bringing two pieces of metal into contact, completes a metallic circuit in connection with the battery; and the mysterious current is made to flow through an electro-magnet, which attracts to it a piece of steel, and drawing it up a ratchet-wheel is caused to move one tooth forward, and the index-hand or finger of a dial to be pushed forward one degree. As each degree upon this dial is numbered, the hand advancing from number to number indicates how many persons have passed over the step at the omnibus door since the dial was set. The machinery is so arranged as to indicate the number of persons who have got up outside the omnibus, as well as those who have got in; a wire being carried to the step by which the outside is mounted. It has the protection of a strong iron covering, with which it would be impossible for the conductor to tamper; and nothing but breaking the box by main force could interfere with the operation. The dial-plate having two hands and two circles of figures, the degrees in one indicating units and in the other hundreds, provision is made for numbering 5000 passengers. This prevents the possibility of a conductor, within the time that he is out with his omnibus, working the dial nearly round by getting so many times in and out himself, and so causing the index finger to point to a number somewhat short of the right. A passenger lingering on the step, or stamping two or three times upon it, will still only mark as one, no second mark being possible until after he has cleared the step and taken his whole weight off it. The dial-plate may be privately set at any number on starting; and if the system of half fares for portions of the journey be continued, it could be ascertained how many of the passengers were "long," and how many "short," by placing a person at the boundary line, whether Regent Circus or Charing Cross, or elsewhere, there to unlock the box, look at the dial, and note down the number to which the index might point. The conductor will have a step to himself for ascending to his post; the passengers' step he must tread as carefully as a toll-collector on Waterloo Bridge his wicket, because a passenger once fully on the step "makes his mark," and must be counted. A guard is to be attached to the lower part of the door to cover the step when the door is closed. The expense of putting up this mechanism will be trifling. Of course, the apparatus may be used for many other things besides omnibuses; on

bridges, for instance, and piers, and at public gardens and theatres, and wherever people may be made to tread upon a moveable platform or pass through a turnstile.—*Expositor*, No. 2.

MESMERISM AS A MECHANICAL POWER.

Some most interesting experiments by Dr. Elliotson, in which patients, by a reinforcement of mesmeric power, were shown capable of swinging round largs weights *impossible to be even lifted by them in their ordinary condition*, prove an intimate connection between the mesmeric medium and the muscular force, which, as every one knows, is dependent on the state of the nerves, and by them conducted from the brain. And so also with natural sleep-walkers, "they will stand self-balanced on the ridge of a house, where, under the usual conditions of consciousness, they could not preserve their equilibrium for a single moment."—*Rev. C. H. Townshend's Facts in Mesmerism.*

COMPARATIVE VALUE OF HEAT AND ELECTRICITY AS MOTIVE AGENTS.

The following remarks on Petrie's calculations of the Comparative Value of Heat and Electricity as Motive Agents are given by Mr. Samuel Hockling in the *Athenæum.* Mr. Petrie states, "that the best Cornish engines only yield one-fourteenth of the power that the combustion of the carbon actually represents. Now, if we consider the heating value of the coals to be represented by the quantity of carbon which they contain, it will be found that one pound of coal of a good quality, and such as will raise in the best Cornish engine 100,000 lbs., 1 foot high, will have heating power equal to above 10,000°,—which, being multiplied by Mr. Joule's equivalent of 700, as used by the author, we shall have for the theoretical power of 1 lb. of coal the sum of 700,000, and the practical result in the Cornish engine being the sum of 1,000,000, or one-seventh " of the power that the combustion actually represents." The author has not therefore given a correct statement of the practical value obtained from heat. It is, in fact, just double the value which he has given it. The comparative cost of power obtained from heat and electricity, according to the author's statement of the quantity of zinc required per horse-power per hour, theoretically and practically:—Theoretically, the consumption of zinc in the battery should be 1·56 pound per hour per horse-power. Practically, it is from 50 to 60 pounds per hour. Assuming that the price of zinc is 20*l.* per ton, and the price of coal 10s. per ton, their relative price will be as 40 to 1. *Two pounds of coal* per hour will, used in the best Cornish engine, produce the power of one horse; and to produce the same amount of power by the best electro-magnetic engine, *fifty pounds of zinc* must be consumed. Their comparative cost will therefore be as $\left(\frac{40+50}{2}-1{,}000\right)$ 1,000 to 1. Even supposing with the author, that engines may be

constructed to give one-fourth of the theoretical power, the cost compared to the cost of coal will be as $\left(\frac{6{\cdot}24+40}{2}-124{\cdot}8\ 1\right)25$ nearly to 1."

WHISHAW'S IMPROVED TELEKOUPHONON.

Among the various ingenious matters of the present day, may be especially mentioned Mr. Whishaw's Telekouphonon, or Speaking Telegraph, which is gaining ground in public estimation daily. Several of the largest establishments in the City of London have been furnished with this useful substitute for bells: and twenty lines of such telegraph have been fixed at the new Army and Navy Club-house in Pall Mall. An important addition has lately been made by the inventor to the mouth-piece, so as to indicate the particular room from whence notice has been given. This is effected by a small piston and rod working in a cylinder; at the end of the rod is a brass boss which projects before the board in which the mouth-pieces are fixed. When the whistle is sounded, the boss, by the action of the disturbed column of air within the tube which forces out the piston, advances about half an inch in front of the board; so that if the back of the person who is called by one of the whistles they sounded is turned at the time, he can at once discover the particular room from which the call has been made.

MARINE PROPULSION—MACINTOSH'S SUBSTITUTE FOR THE SCREW.

This remarkable improvement in the machinery for propelling steam vessels is the invention of Mr. Macintosh, and is manufactured at the Cyclops Steel Works, Sheffield. The propellers hitherto in use have been invariably made from cast metal, and when at rest or in motion are a perfect screw, *always* at the *same* pitch. The improved flexible propeller (Macintosh's) to which we refer, is made of steel well hammered and tempered, and set at an angle on the revolving shaft. When at rest it is a perfect plane, but when in action it forms a screw; and, by the flexibility of the steel, assumes a finer or a coarser pitch according to the strength of the adverse action of the water through which it moves. This circumstance imparts to the vessel and machinery an easy action, especially in rough and heavy seas, which has never been attained by the rigid screws now in use. Propellers manufactured according to this patent are not more than half the weight of those made of cast metal, though the forgings are the largest yet attempted to be made from steel. It has been ascertained by experiment that, in point of speed, there is a gain of at least 20 per cent. In heavy seas or rough weather this propeller can be easily hoisted on board by means of a simple block and tackle, thus saving the expense of the machinery now used for raising the cast metal ones; and, from being malleable and tough, does away with the risk of breakage which necessarily ensues in the moving a cumbersome piece of cast metal. In cost there is a saving of about 50 per cent. This is considered to be one of the greatest mprovements yet made in marine propulsion.—*Sheffield Times.*

Natural Philosophy.

THE BAKERIAN LECTURE.—MAGNETIC AND DIAMAGNETIC CONDITION OF GASES.

On Nov. 28, 1850, the Bakerian Lecture was delivered by Prof- Faraday to the Royal Society.

One of the conclusions arrived at by the author is, that the motions of magnetic and diamagnetic bodies in each other do not appear to resemble those of attraction or repulsion of the ordinary kind, but to be of a differential action, dependent perhaps upon the manner in which the lines of magnetic force were affected in passing from one to the other during their course from pole to pole, the differential action being in ordinary cases between the body experimented with and the medium surrounding it and the poles. A method of showing this action with the gases is described, in which delicate soap-bubbles are made to contain a given gas, and then, when held in the magnetic field, approach, or are driven further off, according as they contain gases, magnetic or diamagnetic, in relation to air. Oxygen passes inwards or tends towards the magnetic axis, confirming the results formerly described by the author.

Perceiving that if two like bubbles were set on opposite sides of a magnetic core or keeper cut into the shape of an hour-glass, they would compensate each other, both for their own diamagnetic matter and for the air which they would displace; and that only the contents of the bulbs would be virtually in a different relation to each other,—the author passed from bubbles of soapy water to others of glass, and then constructed a differential torsion balance, to which these could be attached, of the following nature:—A horizontal lever was suspended by cocoon silk, and at right angles to the end of one arm was attached a horizontal cross-bar, on which, at about 1½ inch apart, and equidistant from the horizontal lever, were suspended the glass bubbles; and then the whole being adjusted so that one bubble should be on one side of the iron core and the other on the other side, any difference in their tendency to set inwards or outwards from the axial line causes them to take up their places of rest at different distances from the magnetic axis; and the power necessary to bring them to an equidistant position becomes a measure of their relative magnetic or diamagnetic force.

In the first place, different gases were tried against each other, and when oxygen was one of them it went inwards, driving every other outwards. The other gases, when compared together, gave nearly equal results, and require a more delicate and finished balance to measure and determine the amount of their respective forces.

The author now conceived that he had attained to the long-

sought power of examining gaseous bodies in relation to the effects of heat and the effects of expansion separately; and proceeded to an investigation of the latter point. For this purpose he prepared glass bubbles containing a full atmosphere, or half an atmosphere, or any other proportion of a given gas; having thus the power of diluting it without the addition of any other body. The effect was most striking. When nitrogen and oxygen bubbles were put into the balance, each at one atmosphere, the oxygen drove the nitrogen out powerfully. When the oxygen bubble was replaced by other bubbles containing oxygen, the tendency inwards of the oxygen was less powerful; and when what may be called an oxygen vacuum (being a bulb filled with oxygen, exhausted, and then hermetically sealed) was put up, it simply balanced the nitrogen bubble. Oxygen at half an atmosphere was less magnetic than that at one atmosphere, but more magnetic than other oxygen at one-third of an atmosphere; and that at one-third surpassed the vacuum. In fact, the bubble with its contents was more magnetic in proportion to the oxygen it contained. On the other hand, nitrogen showed no difference of this kind; whether a bubble contained that gas more or less condensed, its power was the same. Other gases (excepting olefiant and cyanogen) seemed in this first rough apparatus to be in the same condition.

Hence the author decides upon the place for zero, and concludes that simple space presents that case. When matter is added to space it carries its own property with it there, adding either magnetic or diamagnetic force to the space so occupied in proportion to the quantity of matter employed; and now thinking that the point of zero is well determined, he concludes to use the word magnetic as a general term, and distinguish the two classes of magnetic bodies into paramagnetic and diamagnetic substances.—*Philosophical Magazine*, No. 253.

REWARDS, &c. FOR SCIENTIFIC PURPOSES.

THE following is an account, in detail, of the manner in which the £1,000 voted annually for rewards, experiments, and other expenses for Scientific Purposes during the last three years, has been expended:—1847, 1848.—Salary of Mr. J. W. Hay, as chemical lecturer of Portsmouth Dockyard, between January 1 and June 30, 1847, £37. 10s.; payment to Dr. Andrew Ure, for making an analysis of coal from Vancouver's Island, £10. 10s.; entertainment of Mr. F. P. Smith, patentee of the screw propeller, on board the *Fairy*, tender to Her Majesty's yacht *Victoria and Albert*, £15. 9s.; compensation to Lieut. Julius Roberts, Royal Marine Artillery, for his services and expenses while improving the method of pivoting guns, from the year 1845 to the year 1848, £250: total, £313. 9s. 1848, 1849—Payment to Mr. A. G. Carle for rocket apparatus, &c. supplied for trial at Harwich for the purpose of effecting communication with stranded vessels, £31. 8s.; gratuity to Mr. J. T. Towson, for his services in preparing tables for great circle sailing, £100.;

payment to Mr. John Prideaux, metallurgic chemist, for various analyses of copper sheathing, &c., for the Committee on Metals, £17. 1s.; payment to Mr. Charles Brooke, for his invention and establishment at the Royal Observatory of the apparatus for the self-registration of magnetical and meteorological phenomena, £500; gratuity to Commander H. B. Weston, of the Hon. East India Company's service, for his discovering a method of finding the longitude by chronometer at sunrise and sunset, with tables, £100: total, 748. 9s. 1849-50.—Allowance to Commander A. B. Beecher, to defray the expenses incurred by him in the Editorship of the *Nautical Magazine*, £95; allowance to Mr. James Gordon, to enable him to publish a work, intituled, "The Lunar and Time Table," £50: total £100.—*Daily News.*

EFFECT OF RESPIRATION ON AIR.—PHYSIOLOGICAL ELECTRICITY.—POLARIZATION OF LIGHT.

Mr. Grove has read to the Royal Institution, a paper "On some recent Researches of Foreign Philosophers." Mr. Grove first noticed the experiments of M. Regnault. He gave a short summary of the progress of knowledge respecting the Effect of Respiration on Air from the days of Boyle to the investigations of Messrs. Allen and Pepys; and mentioned that the last-named philosophers tended to show that the amount of carbonic acid gas exhaled from the lungs was an exact equivalent to the amount of oxygen inhaled from the atmosphere; but in all experiments hitherto made the air inspired was, after the first inhalation, more or less deteriorated. The arrangements of Mr. Regnault have effected an uniformity not only of the quality, but also of the temperature and pressure of the atmosphere respired by the animal under experiment. A diagram of M. Regnault's apparatus, and the actual eudiometer employed by him to test the exhaled gases, were exhibited. The following may be taken as the most important results of many experiments:—1. Warm-blooded animals exhale nitrogen in proportion from $\frac{1}{100}$ to $\frac{1}{10}$ of the oxygen consumed by them in respiration. 2. Animals fed on farinaceous food exhale carbonic acid equivalent to the oxygen inspired; while animals fed on animal food absorb oxygen sometimes equal to 4 parts in 10 of that inspired. 3. Animals fed on leguminous food absorb a quantity intermediate between that occasioned by a flesh and a cereal diet. 4. The consumption of oxygen by animals varies directly with the surface, and inversely with the bulk of their bodies,—*e. g.*, a sparrow consumes ten times more oxygen in a given time than a common domestic fowl; this arises probably from the cooling effect of the greater surface. 5. Hybernating animals when asleep in some cases assimilate the oxygen and nitrogen of the atmosphere which they inhale, and increase in weight by respiration alone. 6. Experiments had been tried on a dilution of oxygen with other gases. Mr. Grove showed a cage containing two small birds placed under a large bell glass containing an atmosphere of hydrogen and oxygen mixed in the proportions that

constitute water. The carbonic acid formed by the respiration of the birds was absorbed by lime-water, and fresh supplies of oxygen and hydrogen were given by the decomposition of water by a voltaic battery. No inconvenience appeared to be experienced by the animals in consequence of the novel atmosphere in which they were placed, and in which they continued during the period of the discourse. Mr. Grove, however, remarked that whatever might be the value of experiments tried with hydrogen, &c., (as proving that they might be temporarily substituted for nitrogen in the atmosphere as diluents of oxygen), inasmuch as Nature did nothing in vain, there must be some yet undiscovered final cause in the selection of nitrogen for this purpose. In concluding this part of his subject, Mr. Grove mentioned, as a proof of the delicacy of M. Regnault's apparatus, that he was able to count the pulsations of the animal submitted to experiment by the number of bubbles of oxygen gas supplied to it by the apparatus. Mr. Grove also took occasion to suggest that all these experiments, as well as the more striking effects of chloroform and ether, pointed strongly to the probable efficiency of gases inhaled by the lungs as therapeutic agents. The subject had received much less consideration than its importance deserved. Small admixtures of certain gases with the ordinary atmosphere were known to produce peculiar effects on the animal economy, and such admixture he thought might be found in certain cases beneficial. Thus, as Nature gives us more carbonic acid gas in the atmosphere by night than by day, and as hybernating animals will in their dormant state live in an atmosphere containing much more carbonic acid than they could bear in their wakened state, Nature seems to point out to us that the admixture of certain portions of carbonic acid with the air of invalids' rooms might be useful as a soporific agent, and more natural and effective than those taken by the stomach. Other applications of the principle might be discovered by experiment.

Mr. Grove then spoke of a memoir on Physiological Electricity by Signor Matteucci, of Pisa, recently read at the Royal Society. Signor Matteucci believes that he has been able to trace a connection between the direction of the electrical current and the influence of that current as affecting motion or sensation. Thus, for example, when the current passes from the anode to the cathode of the battery through the muscles of the animal, *motion* only is caused, and *sensation* only when the current is sent in the opposite direction. In illustration of these facts, Mr. Grove mentioned that, at the commencement of his own researches, he had been requested by a friend, whose lower extremities were paralyzed, to try the effect of electricity in restoring the voluntary motion that was lost; that, in compliance with this request, he subjected the leg and thigh to such currents as in a normal state of the body would have occasioned an involuntary contraction of the limbs without sensation; and that in the case of this gentleman no movement of the limbs resulted, but violent pain was produced.

The last subject noticed by Mr. Grove was the experiments of M. Pasteur on the relation of Crystalline Forms to Polarization of Light. M. Pasteur, in examining the salts of crystallized paratartaric acid, had noticed two sets of oppositely hemihedral crystals, and on making separate solutions of these crystals he found that the solution of one class rotated the plane of polarization to the right, while the other class rotated it to the left; a mixture in proper proportion of the two solutions produced no effect on the plane of polarization. What makes this the more curious is, that the chemical constitution of the three solutions is identical. (Vide "Annales de Chimie," 3e série, 1848, t. xxiv. p. 442.)—*Athenæum*, No. 1158.

TIDE RESEARCHES.

THE REV. DR. WHEWELL has communicated to the Royal Society, the Fourteenth Series of his Researches "On the Results of continued Tide Observations at several places on the British Coasts."

Tide observations made at several different parts of the British and neighbouring shores, and in some instances continued for a considerable period, having been discussed by Mr. D. Ross, of the Hydrographer's Office, with great labour and perseverance, a brief statement of the results which his labours afford is here presented by Dr. Whewell.

The discussions here referred to relate to the height of high water, and the variations which this height undergoes in proceeding from springs to neaps, and from neaps to springs. It is found, by examining the observations at 120 places, and throwing the heights into curves, that the curve is very nearly of the same form at all these places. Hence the semi-mensual series of heights at any place affords a rule for the series of heights at all other places where the difference of spring height and neap height is the same. For instance, Portsmouth, where the difference of spring height and neap height is 2 ft. 8 in., is a rule for Cork, Waterford, Inverness, Bantry, Arcachan on the French coast, and other places: and the tables of the heights of high water at one of these places suffices for all the others; a constant being of course added or subtracted according to the position of the zero-point from which the heights at each place are measured.

The series of heights of high water for a semi-lunation also agrees very exactly, as to the form of the curve, with the equilibrium theory. A very simple construction is given for the determination of this curve. The properties deduced according to theory from this construction are, however, in actual cases, modified in a manner which is then described.

1. The Tides in these discussions are not referred to the transit of the moon immediately preceding, but to some earlier transit, namely, the second, third, fourth or fifth preceding transit, it being found that in this way the accordance with the theory becomes more exact.

2. According to this construction, the difference of springs and neaps would be to the height of neaps above low water springs as 10 to 24, a constant ratio for all places : but in fact this ratio is different at different places ; and the observations under consideration show that the ratio is smaller where the tide is smaller.

In consequence of the law of the high water, given alike by the theory and by the observations, the spring high waters are above the mean high water for a longer period than the neaps are below it.

ATLANTIC WAVES, THEIR MAGNITUDE, VELOCITY, AND PHENOMENA.

Dr. Scoresby has communicated to the British Association, the following interesting paper :—During *two* passages across the Atlantic in 1847-8, I had opportunities for investigating certain elements respecting deep-sea waves more favourable than had ever before occurred within my experience in navigation. These observations, it should be noted in the outset, and the results deduced from them, were entirely uninfluenced by, and separate from theory. They form but a contribution to this interesting branch of natural phenomena ; but I offer them the more readily from the circumstance of their entire independency and speciality. It was in our return voyage from America that the highest seas occurred, when the circumstances adapted for interesting observations were singularly favourable ; for, whilst the magnitude and the peculiar construction of the upper works of the ship—the Hibernia—afforded various platforms of determinate elevation above the line of flotation for observations on the height of the waves, the direction of the ship's course, with respect to that of waves, was generally so nearly similar as to yield the most advantageous agreement or accordance for observations on their width and velocity. These observations I shall extract, in their order, from my Journal kept during the homeward passage.

My first observation worth recording is under the date of March 5th, 1848, when the ship was in latitude about 51°, and longitude (at noon) 38° 50′ W.—the wind then being about W.S.W., and the ship's course, true, N. 52° E. At sunset of the 4th the wind blew a *hard gale*, which, with heavy squalls, had continued during the night ; so that all sail was taken in but storm-staysail forward. The barometer stood at 29·50 at 8 P.M., but fell so rapidly as to be at 28·30 by 10 the next morning. In the afternoon of this day I stood some time on the saloon deck or cuddy roof,—a height, with the addition of that of the eye, of 23 feet 3 inches above the line of flotation of the ship,—watching the sublime spectacle presented by the turbulent waters. I am not aware that I ever saw the sea more terribly magnificent. I was anxious to ascertain the height of these mighty waves ; but found almost every wave rising so much above the level of the eye, as indicated by the intercepting of the horizon of the sea in the direction in which they approached us, as to yield only the *minimum* elevation, and to show that the great majority of these rolling masses of water possessed a height of considerably *more* than 24 feet (including depression as well as altitude,) or, reckoning from the mean level of the sea, of *more* than 12 feet. Exposed as the situation was, I then adventured to the larboard paddle box, which was about 7 feet higher, where the level (as ascertained afterwards at Liverpool, allowance being made for the alteration in the draught of water of the ship,) was 24 feet 9 inches above the sea. This position, with 5 feet 6 inches, the height of my eye, gave an elevation altogether of 30 feet 3 inches for the level of the view then obtained,—a level, it should be remarked, which was very satisfactorily maintained

during the instants of observation, because of the whole of the ship's length being occupied within the clear "*trough* of the sea," and in an even and upright position, whilst the nearest approaching wave had its maximum altitude. Here, also, I found at least *one half* of the waves which overtook and passed the ship were far above the level of my eye. Frequently I observed long *ranges* (not acuminated peaks) extending 100 yards, perhaps, on one or both sides of the ship,—the sea then coming nearly right aft,—which rose so high above the visible horizon, as to form an angle estimated at 2 to 3 degrees (say $2\frac{1}{2}°$) when the distance of the wave summit was about 100 yards from the observer. This would add near 13 feet to the level of the eye. And this measure of elevation was by no means uncommon,—occurring, I should think, at least once in half a dozen waves. Sometimes peaks of crossing or crests of *breaking* seas would shoot upward at least 10 or 15 feet higher. The *average wave* was, I believe, fully equal to that of my sight on the paddle-box, or more,—that is, $\frac{30}{2} = 15$ feet, or upwards; and the *mean highest waves*, not including the broken or acuminated crests, about 43 feet above the level of the hollow occupied at the moment by the ship. Illuminated as the general expanse not unfrequently was by the transient sunbeam breaking through the heavy masses of the storm-cloud, and contrasting its silvery light with the prevalent gloom, yielding a wild and partial glare, the mighty hills of waters rolling and foaming as they pursued us, whilst the gallant and buoyant ship —a charming "sea-boat"—rose abaft as by intelligent anticipation of their attack, as she scudded alo g, so that their irresistible strength and fierce momentum were harmlessly spent beneath her and on her outward sides,—the storm, falling fiercely on the scanty and almost denuded spars and steam chimney raised aloft, still indicated its vast, but as to us innoxious, power, in deafening roarings,—altogether presented as grand a storm-scene as I ever witnessed, and a magnificent example of "the works of the Lord," specially exhibited to sea-going men, "and his wonders in the deep." In the afternoon of the same day the gale again increased, blowing, especially during the continuance of a much protracted hail-shower, terrifically,—roaring like thunder whilst we scudded before it, causing the ship to vibrate as by a sympathetic tremor, and the tops of rolling waves, too tardy, rapid as was their actual progress, for the speed of the assailing influence, to be carried off and borne along on the aerial wings in a perfect drift of spray! But during the period of these most vehement operations of nature, I was fortunately enabled, from familiarity with sea enterprise, to pursue my observations with entire satisfaction.

The next day (March 6) added to the interest of these investigations by developing the character of the Atlantic waves under a long and fiercely-continued influence of a little varying wind. It had blown a heavy gale, violent in the showers, from the north-westward, from Saturday evening the 4th, to the evening of Sunday, from 26 to 30 hours; during the night, too, of Sunday it had again blown hard (abating towards the morning of Monday), and making a total continuance of the storm, in *its violence*, of about 36 hours.* I renewed my observations on the waves at 10 A.M.—the storm having been then subdued for several hours, and the height of the waves having perceptibly subsided. Soon I observed, when standing on the saloon-deck, that ten waves, in one case, came in succession, which all rose above the apparent horizon,—consequently they must have been more than 23 feet: probably the *average* might be about 26 from ridge to hollow. At this period I also found that occasionally (that is, once in about four or five minutes) three or four waves in succession, as seen from the paddle-box, rose *above* the visible horizon,—hence they must, like those of the preceding day, have been 30 feet waves. But one important *difference* should be noted—viz. that they were of no *great* extent on the ridge, presenting, though more than mere conical peaks, but a moderated elongation. Another subject of consideration and investigation, on this occasion, was the period of the regular waves overtaking the ship, and the determination, proximately, of the actual width or intervals, and their velocity.

* The barometer on Saturday, at 8 P.M., was at 29·50; at 6 A.M. of Sunday it had fallen to 28·30: being 1·2 inches in 10 hours. At 6 P.M. of the latter day it had risen to 30·00 inches.

1. The ship was then going *nine* knots only, the free action of the engines being greatly interfered with by the heavy sea running, and the lines of direction of the waves and the ship's course differed about 22½ degrees, the sea being two points on the larboard quarter,—in other words, the true course of the ship was east; the direction *from* whence the sea came was W.N.W. 2. The period of regular waves, in incidental series, overtaking the ship, were observed as follows:—

Waves.		Min.	Sec.	Mean.
20	occupied	5	30	16″·5
10	"	2	35	15 ·5
10	"	2	50	17 ·0
10	"	2	45	16 ·5
8	"	2	16	17 ·0
General average....				16 ·5

3. The length of the ship was stated to be 220 feet. The time taken by a regular wave to pass from stern to stem appeared, on a mean of several observations, to be about six seconds. Hence 6″ : 220 feet (the width passed passed over in that time) : : 16·5 feet to 605 feet (the width passed over betwixt crest and crest.) But this extent, by reason of the obliquity of the direction of the waves to the course of the ship, is found to be elongated about 45 feet, reducing the probable mean distance of the waves to 559 feet. Independently of this process, I had previously estimated the distance of the wave crests, ahead and astern when the ship was in the hollow, as I stood near the centre of the ship's length on the paddle-box, at 300 feet each way, by comparing the intervals betwixt my position and the place of the wave-crest, with the known length of the ship. This comparison, frequently reconsidered and repeated, subsequently yielded, in much accordance with the former, a total width, in the line of the ship's course, of about 600 feet. 4. But the total distance betwixt the crests of two waves, then reckoned at 550 feet, a distance passed by the wave in 16·5 seconds of time, by no means indicates, it is obvious, the real velocity of the wave. as the ship meanwhile was advancing nearly in the same direction at the rate of nine knots, that is, nine geographical miles, or (6,075·6 feet + 9 =) 45,680·4 feet per hour, or 15·2 feet per second. During the time, therefore, of a wave passing the ship = 16·5″, the ship would have advanced on its course 16·5 + 15·2 = 250·6 feet. Reducing this for the obliquity of two points we have 231·5 feet to be added to the former measure, 559 feet, which gives 790·5 feet for the actual distance traversed by the wave in 16·5 seconds of time, being at the rate of $\left(\frac{3{,}600'' \times 790{\cdot}5}{16{\cdot}5} =\right)$ 17,251·7 feet, or 32·67 English statute miles per hour. To know how far this result is but proximate, it should be considered that, of the several elements employed in the calculation, all but one might be deemed accurate. The interval of time occupied by the transit of a wave with respect to the position of the ship, the *direction* of the ship's motion with relation to that of the waves, and the speed of the ship through the water,—may all be recorded as, essentially, accurate. The element in doubt is that of the average distance from summit to summit of the waves. This distance, it has been seen, was, by a twofold process of observation or comparison, accordantly assumed. The value of the judgment derived from rapid comparison of measures by an eye accustomed to such estimations is, it should be observed, far higher than might be generally considered. The practical military commander or engineer officer is able to make, by mere inspection of the ground before him, remarkably close estimates of spaces and distances. When engaged in the Arctic whale fishery, I was enabled, from habit and comparison of unmeasured spaces with known magnitudes, to estimate certain distances with all but perfect accuracy. Thus, as to a circumstance in which we were most deeply interested—the near approach of a boat to a whale—I found it quite practicable, whenever the pursuing boat approached within twice or thrice its length (except when the position was near end on) to estimate the distance to less than a yard. Now, the means of comparison by the eye as to the estimation of the breadth of the Atlantic waves, was that of the ship's length of 220 feet. When the ship was fairly in

the middle of the depression betwixt two waves it was assumed, with reference to this known measure, that something obviously less, but not greatly so, than the ship's length, was the distance of each of the two waves then contemplated—giving a total width of about 600 feet. But the comparison of the time required by a wave to pass from stern to stem, with the average time of transit of an entire wave, yielded a much better result; and, on much consideration of the subject, I am inclined to believe that the estimate is a tolerably close approximation to the truth. It should be observed, too, that as the headway of the ship, in the direction of the course of the wave—being a known quantity—it was favourable to the accuracy of the estimate. For, assuming an error in the width of the waves to have occurred—say to the amount of one-twelfth of the whole, or 49 feet—the effect upon the calculated velocity of the wave would have been only about a sixteenth, or 2·16 miles per hour.

The form and character of these deep-sea waves became at the same time interesting subjects of observation and consideration. In respect to form, we have perpetual modifications and varieties, from the circumstance of the inequality of operation of the *power* by which the waves are formed. Were the wind perfectly uniform in direction and force, and of sufficient continuance, we might have in wide and deep seas waves of perfectly regular formation. But no such equality in the wind ever exists. It is perpetually changing its direction within certain limits, and its force too, both in the same place and in proximate quarters. Innumerable disturbing influences are therefore in operation generating the varieties more or less observable in natural sea waves.

In regard to my own observations of the actual forms of waves, nothing particularly new could be expected from an inquiry of this kind in regard to phenomena falling within the perpetual observation of sea-going persons; yet, at the risk of stating what might be deemed common, I will venture to transcribe from my notes made with the phenomena before me, the leading characteristics which engaged my attention. During the height of the gale (March 6th) the *form* of the waves was less regular than after the wind had, for some time, began to subside. Though in many cases when the sea was highest the succession of the primary waves was perfectly distinct, it was rather difficult to trace an identical ridge for more than a quarter to a third of a mile. The grand elevation in such case sometimes extended by a straight ridge, or was sometimes bent as of a crescent form, with the central mass of water higher than the rest, and, not unfrequently, with two or three semi-elliptical mounds, in diminishing series, on either side of the highest peak. These principal waves, too, it should be noted, were not continuously regular, but had embodied in their general mass many minor, secondary, and inferior waves. Neither did the great waves go very prevalently in long parallel series like those retarded by shallow water on approaching the shore; but every now and then changed into a bent cuneiform crest with breaking acuminating peaks.

On the following morning (March 7), after a second stormy night, wind S.S.W. (fine), we had a heavy and somewhat cross sea (from the change of wind from W.S.W. to S.S.W.) But the almost unabated magnitude of the more westerly waves indicated a continuance of the original wind at some distance astern of us. The gale had moderated at daylight, and the weather became fine; but as the sea still kept high, its undulations became more obvious and easily analysed. At three in the afternoon, when about a third part of the greater undulations averaged about 24 feet from crest to hollow, in height, these higher waves could be traced right and left as they approached the ship to the extent of a quarter of a mile on an average, more or less. Traced through their extent, the ridge was an irregular roundbacked hill, precipitous often on the leeward side of waters. The undulations, indeed, as to primary waves, consisted mainly of these roundbacked masses, broken into or modified by innumerable secondary and smaller waves within their general body. The time in which these waves passed the ship was now, on an average, about 15 seconds, the ship's speed being increased from 9 to 11 knots; and the obliquity of the ship's course to the direction pursued by the waves was 3 points.

On the 9th, two days after the above condition of the waves—whilst the

sea yet ran high—few waves could be traced, continuously, above 300 to 400 yards in extent along the same ridge. The crests often curled over, but none so as to reach the height of a 30-feet wave, and broke for a wide space, estimated at 50 to 100 yards in continuity.

Miscellaneous Notes and Suggestions.—The mode adopted in these researches of finding the *height* of wave is, I believe, quite satisfactory, and, observed with care and with relation to numbers or proportion of waves, as accurate as need be. The depression of the horizon in respect to the elevation of the observer is too small to form even a correction. As the horizon from the paddle-box, $\frac{30}{2}$ 15 feet, had only a depression of 3′ 49″, the distance of the visible horizon, as seen from this elevation, would be 4·45 statute miles, and the actual depression in feet due to the distance of the summit of the wave when the ship was in the midst of the hollow, could only be 0·18 foot or 2·16 inches. Other modes of determining the width of a wave—or the extent betwixt summit and summit—much preferable to that described (the only available one I could devise), might easily be adopted where the management of the ship was in the hands of the observer. In steam ships the simplest mode for high seas, perhaps, would be, altering the speed of the ship when going in the direction of the wave or against the wave; the ratios of the time of transit of wave-crests, under different rates of sailing of the ship, might yield results very close to the truth. In moderate-sized waves, the plan adopted by Capt. Stanley—whose observations I met with before this meeting—seem satisfactory. But in calms, or moderate weather after a storm,—that is, for the determination of the velocities of less elevated waves—a variety of processes might be available.

The author referred, in conclusion, to the *forms* of wave crests, and heights, modified by crossings, interferences, and reflections.

Mr. Scott Russell felt a familiar interest in the results of these observations. The Section was aware that great doubts existed as to the actual heights of the waves of the open ocean. It was now past all doubt that waves 24 feet high, 30 feet high, 43 feet high, and with the swelling crest even exceeding 45 feet high, actually existed and were observed. From the observations which he had conducted many years since, he had ventured to draw up a table predicting the velocities of sea waves up to even 1,000 feet from trough to crest in length. Although the apparatus which he had used did not enable him to experiment on waves which exceeded 16 inches in length yet from these pigmy waves it was most interesting to see how accurately the law was obtained; for in his table the velocity of a wave whose length was 600 feet was set down at 30 or 31 miles per hour. Dr. Scoresby's actually observed velocity for this wave was 32 miles and a fraction. Lord Northampton begged to remark that this was one of the many instances of the value of the British Association as a handmaid to science. It brought together two such gentlemen as Mr. Russell and Dr. Scoresby, and showed the accuracy of the laws deduced by one from experiments conducted on a miscroscopic scale, by the test of others observed amid the sublime scene of the great Atlantic.

GREAT ATMOSPHERIC WAVE.

The Spring of 1849 was remarkable for a continuous movement westward of the atmosphere for the space of seventeen days, namely from the 1st to the 18th of February. The mean reading of the barometer during that period was fully half an inch above its average

value; and when the crest of the wave was over Greenwich, the reading of the barometer at the level of the sea was as high as 30·90 m. The base of the wave must have been in extent just about equal to the distance from England to America; for it appears from the "American Traveller," published at Boston on 6th April, 1850, that on the same day that it completed its passage at Greenwich, it was felt for the first time at Boston as it was with us. It must have travelled, therefore, at the rate of about 170 miles a day.

GREAT CIRCLE SAILING.

A VOYAGE to Australia has been made in an unusually short space of time, by adopting the system of Great Circle Sailing, which was brought before the Admiralty about two years since by Mr. John Towson. This new feature in navigation is of such obvious truth and decided advantage, that it is only surprising that navigators have waited till this time of day to adopt so self-evident a fact. The principle is thus popularly explained.

The unprecedentedly short voyage made by the Constance has been acknowledged to have arisen from the application of a simple scientific principle to navigation, by which a month has been saved from the average time occupied by modern voyages. There is nothing visionary or abstract in the principle on which this improvement is founded; but it is one that has obtained the universal consent of civilized mankind—that this earth is a globe. But, as a practical principle, this fact has been too much disregarded by the mariner. His chart is a plane, and by it he has been accustomed to navigate the ocean, and we can scarcely persuade him that the positions of distant lands are otherwise than they appear on the chart. This error was of little importance whilst the Mediterranean Sea was the principal seat of commerce, and the transit of the Atlantic Ocean was an event of rare occurrence. Then it was that Mercator's Chart was received from the hand of its inventor as a most acceptable boon to the navigator. But now a very different order of circumstances exists. The members of the same British family are antipodal to each other, and the chart of half the earth's circumference is more frequently employed than that of the Atlantic had been a few score years since.

Under these circumstances, the Mercator's Chart has become inadequate to meet all the requirements of the navigator. He is now called on by the men of science to regard the earth's true form, and when he undertakes voyages to distant lands to take into consideration the circumstance that the chart is an artificial contrivance, which in many instances may lead him to false conclusions.

To avoid the erroneous conclusions drawn from Mercator's Chart, we would refer the mariner to a work published by the British Admiralty two years since, entitled, 'Tables to facilitate the practice of Great Circle Sailing,' constructed by Mr. John Towson. We do this with greater confidence, since by its aid the Constance emigrant ship has shortened her voyage at least a month. But he will undervalue these tables if he imagines it will only enable him to follow Captain Godfrey in his track to Australia, which route his late voyage has demonstrated to be the best practicable track. It is serviceable in all cases of voyages to regions situated at a great distance east or west of each other, both in shaping his track and in choosing his tack when unfavourable winds prevail; for we are convinced that errors in both these particulars are of daily occurrence, arising from his disregarding the globular formation of the earth.

The track pursued by the Constance is denominated by the author of the work alluded to, "Composite Great Circle Sailing," and is usefully employed when the Great Circle route would lead to impracticable latitudes. In the

Southern oceans it is peculiarly applicable, since in Captain Godfrey's maximum latitude, 50°, favourable winds continually prevail for going out by the Cape and coming home by the Horn. To Australia 900 miles is also saved, and in a voyage to New Zealand 100 miles more. Besides this advantage, the region of storms is avoided. Around the Cape of Good Hope is the only track in which storms prevail which an emigrant ship has to pass after she has crossed the tropic of Capricorn. In future voyages the mariner, by following Captain Godfrey's track, will, to use a sea term, "give the Cape a wide berth;" so that we may anticipate that voyages on Captain Godfrey's track will not only be completed in a shorter period than previously, but that this improvement in navigation will confer the additional advantage of greater degree of safety from wreck.

We are assured by scientific men who are peculiarly qualified to give an opinion on this question, that the system of Great Circle Sailing offers immense advantages:—and we find America and several Continental States are already adopting Mr. Towson's table.

HOURLY METEOROLOGICAL OBSERVATIONS MADE AT THIBET, AT AN ELEVATION OF 18,400 FEET. BY LIEUT. STRACHEY, R.E.

Great interest attaches to these observations from their having been made during 24 hours at an elevation so seldom attained by man: quite above the clouds and most ordinary disturbing influences, and with a barometer pressure somewhat about 14 inches of mercury. The chief result is that the curves follow very nearly the same changes as in the lower regions they are observed to do.

Col. Sykes, in some remarks on these and other observations of Lieut. Strachey, states that the formula of Dr. Apjohn for the reduction of the wet and dry bulb hygrometers is found to be quite inapplicable to Indian climates; the dry bulb being lowered in its indications by the proximity of the wet, and the wet bulb collecting and retaining a wet atmosphere of its own, whose temperature it gave,—not that which it would attain at the lowest, were this atmosphere continually removed; one consequence of which is great discrepancy of result according to the part of a room in which it was placed. Lieut. Strachey corroborates this, and says he has found the numerical co-efficients of Mr. Glaisher, which vary with the temperature, and which that gentleman has tabulated, much more applicable to Indian hygrometry.

MAGNETICAL AND METEOROLOGICAL OBSERVATORIES.

At the recent meeting, at Newhaven, of the American Association for the Advancement of Science, it was "Resolved—That in the foundation and maintenance of numerous Magnetical Meterological Observations, the British Government have evinced an appreciation of the claims of Science, and a readiness to contribute liberally to its support, which challenge the admiration of the scientific world. Resolved—That the experiments which are now in progress at the Toronto Observatory to test the practicability of self-registering photographic methods, the system of concerted auroral observations recently organised by Capt. Lefroy, and the peculiar interest attached to magnetic observations made near the focus of maximum intensity, render it highly desirable that the Toronto Observatory should be

continued in activity for a somewhat longer period. And inasmuch as a very extensive series of meteorological observations, embracing the entire area of the United States, is now in progress of organization by the Smithsonian Institution, and it would add exceedingly to the value of the proposed observations if simultaneous ones could be obtained from the region north of the United States, extending even to the shores of Hudson's Bay and the coast of Labrador; therefore, Resolved—That the British Government and the Directors of the Hudson's Bay Company be invited to co-operate with the observers in the United States in united snd systematic meteorological inquiries.—*Athenæum*, No 1204.

POWERFUL MAGNETS.

Sir David Brewster has read to the British Association, a paper "On some Powerful Magnets made by a process devised by M. Elias, and manufactured by M. Logeman, optician, at Haerlem." Sir David exhibited two of these Magnets: one weighing about 1lb., a single horse-shoe magnet, capable of lifting $28\frac{1}{2}$lb.,—the other a triple horse-shoe magnet, about 10lb. weight (we believe), and capable of lifting about 150lb. He read letters from M. Logeman detailing the prices and qualities of the magnets, which he made for sale, some of which would support 5 cwt. He said that these were made by some peculiar process, in which a helix of copper and galvanic battery were used; that they were so permanent that they suffered little, if at all, from having their soft iron guards forced off several times abruptly; that the common formula by which the power of a magnet was judged of was the weight which it lifted being ten times the cube root of the square of its weight,—but that these were about twice as powerful. They were accompanied by small strops, made with fine emery, for cleaning and polishing the poles and lifter previous to use, which was found to be of much consequence.

The Rev. Dr. Scoresby said he had examined these Magnets as carefully as the means which he had here at his command would admit, and had no doubt they were capable of performing the several matters asserted by their makers. They were of peculiarly good forms for performance,—in fact, precisely the broad flat form, which he had recommended in his book published so long back as 1843; and he had little doubt that by the methods described in that book he was able to produce as permanent and as powerful steel magnets. Now, for these qualities, the using of the best Swedish cast steel and tempered as hard as possible, was the great secret; and although, by the common modes of magnetizing, it was difficult to give the full charge to a magnet, yet by the methods which he had described, especially the interposing a thin plate of very soft iron between the poles of the magnet used to impart the charge and the steel to be magnetized, it became a very easy task. His methods had been adopted by the Admiralty without acknowledgment or thanks.

Mr. Hunt said he thought it highly probable that, in imparting the charge to his magnets, M. Elias raised their temperature, but taking care to do so not to any extent that would injure their temper. He also thought it probable that, as it was well known that ferro-prussiate of potash was used in the case hardening of iron, he used solutions of that salt in some way in his process.

Mr. Waugh stated that a most successful way of imparting magnetism to steel was, as soon as it was ready to be magnetized, placing it in a copper helix midway between the poles; then connect the helix with the poles of a galvanic battery; then pass the bar or horse-shoe towards the one end or pole through the helix, then back along its whole length to the other pole, and then back again to the middle: the connection with the galvanic battery being then broken, the bar, when removed from the helix, would be found fully magnetized.

Dr. Scoresby had tried numerous experiments on the influence of heat in aiding the reception of magnetism: the conclusion he had come to was, that up to 500° it might not be injurious, if proper precautions were taken to prevent the temper, or rather hardness, of the steel from being injured. At and above that temperature he was sure that it prevented the full charge from being imparted. —*Athenæum*, No. 1179.

EIGHTH MEMOIR ON INDUCTION. BY M. ELIE WARTMANN.

THIS Memoir, "On the use of the multiplying Rheometer for measuring differences of intensity of weak or powerful Electric Currents," will be found translated from the *Bibliothèque Universelle de Genève*, in No. 245 of the *Philosophical Magazine*: the following being the conclusion:—

"It follows from these researches that magnetization does not alter the molecular condition developed by the passage of an Electric Current so as to affect its conductibility. The inverse proposition would also be verified in all probability. If, then, electricity results, as some physicists suppose, in ætherial movements depending on the surrounding matter, these movements preserve their intensity when this matter is acted upon by the forces which emanate from the poles of an energetic magnet. This circumstance must be taken into account by the theories which pretend to explain the phenomena of electricity and magnetism."

NICETY REQUIRED IN ASTRONOMICAL CALCULATIONS.—ENORMOUS PROPAGATION OF MINUTE ERRORS.

THE rod used in measuring a base line is commonly somewhere about ten feet long; and the astronomer may be said truly to apply that very rod to mete the distance of the stars. An error in placing a fine dot which fixes the length of the rod, amounting to one five-thousandth of an inch (the thickness of a single silken fibre) will amount to an error of seventy feet in the earth's diameter, of 316 miles in the sun's distance, and to 65,200,000 miles on that of the

nearest fixed star. The second point to which we would advert is, that, as the astronomer in his observatory has nothing further to do with ascertaining lengths as distances, except by calculation, his whole skill and artifice are exhausted in the measurement of angles; for it is by these alone that spaces inaccessible can be compared. Happily, a ray of light is straight; were it not so (in celestial spaces at least), there were an end of our astronomy. If we may be permitted a pleasantry on such a subject, it is our *beam* compass, and it is as inflexible as adamant, which our instruments for ascertaining its position unfortunately are not. Now, an angle of a *second* (3,600 to a degree) is a subtle thing. It has an apparent breadth utterly invisible to the unassisted eye, unless accompanied with so intense a splendour (as in the case of the fixed star) as actually to raise by its effect on the nerve of sight a spurious image having a sensible breadth. A silkworm's fibre, such as we have mentioned above, subtends an angle of a second, at $3\frac{1}{2}$ feet distance; a cricket ball, $2\frac{1}{2}$ inches diameter, must be removed, in order to subtend a second to 43,000 feet, or about eight miles, where it would be utterly invisible to the sharpest sight, aided even by a telescope of some power. Yet it is on the measure of one single second that the ascertainment of a sensible parallax in any fixed star depends; and an error of one-thousandth of that amount (a quantity still unmeasurable by the most perfect of our instruments) would place the star too far or too near 200,000,000,000 miles; a space which light requires 118 days to travel.—*Edinburgh Review.*

COMETARY PHYSICS.

Prof. Smyth, in a paper read to the British Association, states that the points in the Physics of Comets which he had intended to bring in detail under the notice of the Section, might be comprehended in the twelve following axioms or aphorisms—viz. 1. A Comet consists of a nucleus and one or more gaseous envelopes. 2. The nucleus if solid and material is extremely small. 3. This nucleus is excentrically situated in the gaseous envelope. 4. Comets of longest periods have the largest bodies. 5. The more excentric the orbit of a comet the more excentric is the body of the comet. 6. A comet revolves round its shortest nucleoid axis in the time it revolves round the sun. 7. This axis is not always at right angles to the plane of the orbit. 8. There is also a quicker rotation round its longer axis. 9. A comet shines by reflected light, and shows a sensible phase. 10. In proportion to the excentricity of its orbit a comet increases in density, and decreases in size in approaching perihelion, and *vice versâ.* 11. The longer axis of a comet is straight at perihelion and aphelion; but between these is concave towards the aphelion, the curvature being nearly proportioned to the excentricity of the orbit. 12. (Sir J. Herschel.) The component molecules of a comet are held together only by their mutual gravitation, each constituting almost a separate projectile, and describing its own orbit round the sun. In consequence of the great press of busi-

ness before the Section the author confined himself to the illustration of the 9th and 10th of these axioms in connexion with the 12th,—showing by diagrams, how the changing appearances both of the head, the nucleus, and the tail as it swept past perihelion, and particularly the forking observed in the tails of some comets, were simple effects of phase arising from the changing relative position of the illuminating sun, the comet, and the observer. The 10th he illustrated by showing that towards perihelion the several parabolic paths of the parts of the comet by becoming crowded together caused the condensation of the comet, while the contrary took place by the separation of these several orbits towards aphelion. The author exemplified these principles by reference to the great comet of 1845, which, though visible to the naked eye for about three weeks, and to the telescope for more than five, yet in the very short time of less than twenty-four hours swept through that part of its perihelion path cut off by a plane through the sun parallel to the ecliptic, having approached within about 60,000 miles of the sun:—the nearest approach to that luminary ever actually observed.—*Athenæum*, No. 1191.

THE NEBULÆ.

The following paper has been read to the Royal Society:—"Observations on the Nebulæ," by the Earl of Rosse. The object of this communication is to lay before the Royal Society an account of the progress which has been made up to the present time in the re-examination of Sir John Herschel's Catalogue of Nebulæ published in the *Philosophical Transactions* for 1833.

Before describing any of the interesting objects the peculiar features of which the extraordinary powers of the telescope employed for their examination have brought to our knowledge, the author enters on some details concerning the instrument itself. This telescope—which for aperture and the consequent power it possesses for the examination of faint details, must, for a considerable time at least, remain unrivalled—has a clear aperture of six feet, with a focal length of fifty-three feet. It has hitherto been used as a Newtonian, but by the easy application of a little additional apparatus it may be conveniently worked as a Herschelian; and the author thinks it not improbable that, in the further examination of the objects of most promise with the full light of the speculum *undiminished by a second reflexion*, some additional features of interest will come out. The tube reposes at its lower end upon a very massive universal joint of cast-iron, resting upon a pier of stone-work buried in the ground; and it is counterpoised so that it can be moved in polar distance with great facility. The extreme range of the tube in right ascension at the equator is one hour, but greater as the polar distance diminishes. By a little subsidiary apparatus the movement of the telescope can be rendered almost exactly equatorial; but up to the present time this apparatus has not been used, as without it the movement was found to be sufficiently equatorial

for such measurements as have been required. The whole mounting was planned especially with the view of carrying on a regular system of sweeping; but as yet the discovery of new nebulæ has formed no part of the systematic work of the observatory, the known objects which require examination being so numerous that hitherto the observers have been fully occupied with them. A clock movement was part of the original design, but as yet the telescope is not provided with one, and the want of it has not been very much felt. Various micrometers have been tried, but, on the whole, the common wire micrometer with thick lines has been found to succeed the best; for the faint details of the nebulæ are extinguished by any micrometrical contrivance which either diminishes the light of the telescope or renders the field less dark,—and thick lines have been found to be visible without illumination in the darkest night. The telescope has two specula, one about three and a half, and the other rather more than four tons weight. Each is provided with a system of levers to afford it an equable support. Upon this system it was placed before it was ground, and has rested upon it ever since. The systems of levers, with the mode of applying them in the support of the speculum, are described in the paper, and also the precautions taken to guard against strain and consequent flexure of the metal. Notwithstanding these precuations, undoubted evidences of flexure in the speculum have occasionally shown themselves. It has not, however, been found that flexure, even to the extent of materially disfiguring the image of a large star, interferes much with the action of the speculum on the faint details of nebulæ,—although it greatly lessens its power in bringing out minute points of light, and in showing revolvability where, under favourstances, resolution had been previously effected. It is stated that, in the spring of 1848, the heavier of the two specula, for nearly three months, performed admirably, very rarely exhibiting the slightest indication of flexure. It then remained inactive for some time before and after the solstice; and when observations with it were again commenced, it was found to be in a state of strain. On cautiously raising it a little by screws, for the purpose of re-adjusting the levers, it was found that the unequal strain of the screws had produced permanent flexure, so that the speculum did not again perform well until after it had been reground. Recently an alteration has been made in the mode of supporting the lighter of the two specula, which now rolls freely on eighty-one brass balls that support it nearly equably.

After referring to other causes of unequal action, among which the varying state of the atmosphere is one of the most serious, the author remarks that the Society will not be surprised should it be in his power at a future time to communicate some additional particulars even as to the nebulæ which have been most frequently observed. The very beautiful sketches which illustrate the paper, are, it is remarked, on a very small scale, but are sufficient to convey a pretty accurate idea of the peculiarities of structure which have gra-

dually become known. In many of the nebulæ they are very remarkable, and seem even to indicate the presence of dynamical laws that we may perhaps fancy to be almost within our grasp. On examining these sketches, it will at once be remarked, as stated by the author, that the spiral arrangement so strongly developed in H. 1622, 51 Mesier, is traceable more or less distinctly in several of the sketches. More frequently, indeed, there is a nearer approach to a kind of irregular interrupted annular disposition of the luminous material, than to the regularity so striking in 51 Mesier; but it can scarcely be doubted that these nebulæ are systems of a similar nature, seen more or less perfectly, and variously placed with reference to the line of sight. The author adverts to the description of this nebula by Mesier, Sir William Herschel, and Sir John Herschel; and remarks, that, taking the figure given by Sir John, and placing it as it would be seen with a Newtonian telescope, we shall at once recognize the bright convolutions of the spiral which were seen by him as a divided ring. Thus, with each increase of optical power, the structure has become more complicated, and more unlike anything which we could picture to ourselves as the result of any form of dynamical law of which we find a counterpart in our system.

After pointing out the importance of measurements, and the difficulty of taking them satisfactorily, the author states, that of a few of the stars with which the nebula is pretty well studded, measurements with reference to the principal nucleus were taken by his assistant, Mr. Stoney, in the spring of 1849, and that these have been repeated this year during the months of April and May,—and also some measures taken from the centre of the principal nucleus to the apparent boundary of the spiral coils in different angles of position. A hope is then expressed that, as several of these stars are no doubt within reach of the great instrument at Pulkova and at Cambridge, U. S., the distinguished astronomers who have charge of them will consider the subject worthy of their attention. The spiral arrangement of 51 Mesier was detected in the spring of 1845; and the following spring an arrangement, also spiral, but of a different character, was detected in 99 Mesier. The author considers that 3,239 and 2370 Herschel's "Southern Catalogue" are very probably objects of a similar character; and as the same instrument does not appear to have revealed any trace of the form of 99 Mesier, he does not doubt that they are much more conspicuous, and therefore entertains the hope that, whenever the southern hemisphere shall be re-examined with instruments of great power, these two remarkable nebulæ will yield some interesting results.

The author briefly refers to the other spiral nebulæ discovered up to the present time, which are more difficult to be seen, and to clusters in the exterior stars, of which there appears to be a tendency to an arrangement in curved branches. He then passes to the regular cumular nebulæ; in which, although they are perceived

at once to be objects of a very different character, there *still* seem to be something like a connecting link. Among the nebulous stars two objects are stated to be well worthy of special notice,—No. 450 of Sir John Herschel's Catalogue, and *i* Orionis. A representation of No. 450, as seen with the six-feet telescope, is given. It has been several times examined, but as yet not the slighest indication of resolvability has been seen. The annular form of this object was detected by Mr. Stoney when observing alone, but Lord Rosse has since had ample opportunities of satisfying himself that the object has been accurately represented. A representation of *i* Orionis is likewise given. The remarkable feature in this object, the dark cavity not symmetrical with the star, was also discovered by Mr. Stoney when observing alone with the three-feet telescope. Lord Rosse has since seen it several times, and sketched it. A small double star *n*, *f i*, has several openings, but they are not so easily seen. These openings appear to be of the same character as the opening within the bright stars of the trapezium of Orion, the stars being at the edges of the opening. Had the stars been situated altogether within the openings, the suspicion that the nebula had been absorbed by the stars would perhaps have suggested itself more strongly. As it is, the author thinks we can hardly fail to conclude that the nebula is in some way connected with these bright stars,—in fact, that they are equidistant; and therefore, if the inquiries concerning parallax should result in giving us the distance of these bright stars, we shall have the distance of this nebula. The long elliptic or lenticular nebulæ are stated to be very numerous,—and three sketches of remarkable objects of this class are given. In proceeding with the re-examination of Sir John Herschel's Catalogue, several groups of nebulæ have been discovered, in some of which nebulous connection has been detected between individuals of the group, in others not, Sketches of some have been made, and measures taken; but although the subject of grouped or knotted nebulæ is considered one of deep interest, it has not yet been proceeded with far enough to warrant entering upon it in the present paper.

The conclusion of the paper is occupied with remarks relating to each figure, in order to render the information conveyed by it more complete; and these are stated to be for the most part extracts selected from the Journal of Observations.—*Athenæum*, No. 1185.

SIDEREAL AND SOLAR TIME.

The Astronomer-Royal, in a paper read to the Royal Astronomical Society, remarks that, considering the problem of smooth and accurate motion as being now much nearer to its solution than it had formerly been, it might be a question whether, supposing a Sidereal Clock made on the principles he describes to be mounted at the Royal Observatory, it should be used in communicating motion to a Solar Clock. It might by some persons be thought ad-

vantageous, even now, that the drop of the signal-ball (1h. Greenwich mean solar time) should be effected by clock-machinery; and it is quite within possibility that a time-signal may be sent from the Royal Observatory to different parts of the kingdom at certain mean solar hours every day, by a galvanic current regulated by clock machinery. Whether it would be advisable that this should be done by machinery proceeding originally from the sidereal mover, would be a question for consideration at the proper time; but, at all events, the Astronomer-Royal desires to show that the problem is practically possible to an astonishing degree of accuracy. Dr. Henderson, of Newferry, near Birkenhead, has communicated to the Astronomer-Royal, and permitted him to make known to the Society, the following numbers for the teeth of wheels. If there be three spindles, Nos. 1, 2, and 3, No. 1 revolving in a mean solar day of 24 hours, or 86,400 solar seconds; if No. 1 carries a wheel of 247 teeth working in a wheel of 331 teeth on No. 2, and if No. 2 also carries a wheel of 43 teeth working in a wheel of 32 teeth on No. 3; then No. 3 will revolve in 23h. 56m. 4s. 09001. Again, if there be four spindles, Nos. 1, 2, 3, and 4, No. 1 revolving in a mean solar day of 24 hours; and if No. 1 carries a wheel of 96 teeth working in a wheel of 79 teeth on No. 2; and if No. 2 also carries a wheel of 157 teeth working in a wheel of 133 teeth on No. 3; and if No. 3 also carries a wheel of 72 teeth working in a wheel of 103 teeth on No. 4; then No. 5 will revolve in 23h. 56m. 4s.09235. The length of the sidereal day adopted in the *Nautical Almanac* is 90h. 56m. 4s.0906. The approximations to it obtained above are very remarkable. By reversing the same train of wheels, accurate motion corresponding to sidereal time will be made to generate motion corresponding with the same degree of approximation to mean solar time.

VELOCITY OF LIGHT.

Some experiments have been made by M. Fizeau on the Velocity of Light, which are of exceeding interest as affording a very close approximation to the results which have been obtained by the observations of the satellites of Jupiter, and other astronomical methods. The apparatus employed by M. Fizeau is characterized by remarkable ingenuity. The results obtained are so interesting, as giving the velocity with which artificial light travels, and the means by which this is arrived at is so satisfactory, that we shall endeavour to explain, as clearly as is possible in words, the form of the experiment. The experiment is essentially to ascertain the time required by a ray of light to pass from Suresnes to a certain spot on the heights of Montmartre and back again to Suresnes. The distance between these two stations is 8,633 mètres—about two leagues,—consequently, the ray of light traverses 17,266 mètres. The mode of effecting this is as follows:—A point of intense brightness, produced by the oxy-hydrogen light, is concentrated by a lens placed in the window of an apartment on a terrace at Suresnes, and being

received upon a mirror at Montmartre, is reflected back again, along the same line, to Suresnes. This is effected with such exactness by M. Fizeau, that scarcely any deviation of the line of the ray can be detected; the rays going and returning are seen one within the other. Behind the point of light at Suresnes is placed a wheel, which carries 720 teeth, and this is so adjusted that the light shines through the opening, between two of the teeth. An eye placed behind the wheel, when it is at rest, receives the impression of the full ray of light. If the wheel is moved, so that 12·6 revolutions of the wheel pass before the eye in a second, the teeth of the wheel appear continuous, the edge seems semi-transparent, and a moiety of the light is obstructed. The wheel having 720 teeth, each opening occupies 1440th part of the circumference; and as the first interruption or eclipse of the light is produced by the above rate of rotation, it is proved that the light has traversed 17,266 mètres, whilst the wheel has performed $\frac{1}{1440}$th of a revolution. If the speed is increased, more light is obstructed;—these eclipses, it appears, are accordingly relative to the numbers 1, 3, 5, 7,—the rates of rotation being each time increased uniformly. It will be evident by this, that eventually a rapidity is obtained by which all the light is cut off; and that rate gives the value of the time necessary for a ray of light to pass from Suresnes to Montmartre and back again,—the observer seeing, it must be remembered, only the returning ray. By these experiments, M. Fizeau has determined that a ray of artificial light travels at the rate of 70,000 leagues in a second of time. Astronomers have given the rate of solar light at 192,500 miles in a second. This agrees exceedingly near with the results obtained by M. Fizeau,—the differences between French and English measures being taken into account. Although desirous of giving every praise to M. Fizeau for his most ingenious and conclusive experiments, we must not forget that the principle of employing rotating machinery to measure the velocity of bodies in rapid motion is due to Prof. Wheatstone: as will be seen on reference to his paper in our *Philosophical Transactions;* and, as was admitted by M. Arago, in a paper published some years since in the *Comptes Rendus.* In fact, we find that in July, 1835, he proposed to the Royal Society to extend his experiments on the velocity of electricity—"*to measure the velocity of light in its passage through a limited portion of the terrestrial atmosphere.*"—*Athenæum,* No. 1158.

PROPERTIES OF LIGHT.

THERE has been read to the Royal Society, a paper entitled "Experiments and Observations upon the Properties of Light," by Lord Brougham. The author states that the optical inquiries of which he here gives an account were conducted in the first instance under the most favourable circumstances, arising from the climate of Provence, where they were commenced, being peculiarly adapted to such studies: he further states that he subsequently had the great benefit of a most excellent set of instruments made by M. Soleil, of Paris;

remarking, however, that this delicate apparatus is only required for experiments of a kind to depend upon nice measurements; and that all the principles which he has to note in this paper as the result of his experiments are thrown into the form of definitions and propositions, for the purpose of making it shorter and more distinct, and of subjecting his doctrines to a fuller scrutiny. He premises that he purposely avoids all arguments and suggestions upon the two rival theories, the Newtonian or Atomic, and the Undulatory. The following are the author's definitions and propositions.—

Definitions:—1. *Flexion* is the bending of the rays of light out of their course in passing near bodies.—2. Flexion is of two kinds—*inflexion*, or the bending towards the body; *deflexion*, or the bending from the body.—3. *Flexibility*, *deflexibility*, *inflexibility*, express the disposition of the homogeneous or colour-making rays to be bent, deflected, or inflected by bodies near which they pass.

Proposition 1.—The flexion of any pencil or beam, whether of white or of homogeneous light, is in some constant proportion to the breadth of the coloured fringes formed by the rays after passing by the bending body. Those fringes are not three, but a very great number, continually decreasing as they recede from the bending body, in deflexion, where only one bending body is acting; and they are real images of the luminous body by whose light they are formed.

Prop. 2.—The rays of light when inflected by bodies near which they pass are thrown into a condition or state which disposes them to be on one side more easily deflected than they were before the first flexion; and disposes them on the other side to be less easily deflected: and when deflected by bodies they are thrown into a condition or state which disposes them to be more easily inflected, and on the other side to be less easily inflected than they were before the first flexion.

Prop. 3.—The disposition communicated to the rays by the flexion is alternative; and after inflexion they cannot be again inflected on either side; nor after deflexion can they be deflected. But they may be deflected after inflexion, and inflected after deflexion, by acting on the sides disposed, and not by acting upon the sides polarized.

Prop. 4.—The disposition impressed upon the rays, whether to be easily deflected or easily inflected, is strongest nearest the first bending body, and decreases as the distance increases.

Prop. 5.—The fringes made by the second body acting upon the rays deflected by the first, must, according to the calculus applied to the case, be broader than those made by the second body deflecting those rays inflected by the first.

Prop. 6.—When one body only acts upon the rays, it must, by deflexion, form them into fringes or images decreasing as the distance from the bending body increases. But when the rays deflected and disposed by one body are afterwards inflected by a second body, the fringes will increase as they recede from the direct rays. Also, when the fringes made by the inflexion of one body, and which increase with the distance from the direct rays, are deflected by a second body, the effect of the disposition and of the distances is such as to correct the effect of the first flexion, and the fringes by deflexion of the second body are made to decrease as they recede from the direct rays.

Prop. 7.—It is proved by experiment that the inflexion of the second body makes broader fringes or images than its deflexion, after the deflexion and inflexion of the first body respectively; and also that the deflexion fringes decrease, and the inflexion fringes increase with the distance from the direct rays.

Prop. 8.—The joint action of two bodies situated similarly with respect to the rays which pass between them so near as to be affected by both bodies, must, whatever be the law of their action, provided it be inversely as some power of the distance, produce fringes or images which increase with the distance from the direct rays.

Prop. 9.—It is proved by experiment that the fringes or images increase as the distance increases from the direct rays.

These propositions are illustrated by particular instances, and their truth is shown by experiments and by some mathematical investigations. The author concludes his paper by a few observations tending further to illustrate and confirm the foregoing propositions, and for the purpose of removing one or two difficulties which had occurred to others until they were met by facts, and also of showing the tendency of the results at which he had arrived.

PROLONGATION OF LIGHT IN THE NORTH.

An observer records, in the *John o' Groat Journal*, in June last, "So bright have the nights been of late, that any evening during the last fortnight small newspaper print could be read in the open air here at a quarter past 11 o'clock. Last Wednesday night, we were out testing, as an experiment, the possibility of reading thus at midnight, and as the town clock of Wick struck 12 we read a newspaper distinctly by the unassisted light of heaven. Our geographical position is between the 58th and 59th degrees of north latitude."

POLARISED STRUCTURE OF THE EYE.

Sir D. Brewster gave, at the late meeting of the British Association, a short notice on the Polarising Structure of the Eye. He referred to the phenomenon called Haidinger's Brushes. These discoveries prove three different polarising structures in the eye,—in fact, that the eye may be a polariscope. It was difficult to see the brushes. Neither he nor Haidinger can explain the cause of this property. Professor Stokes had also a communication on the same subject. He had seen the brushes with great facility; and he described their appearances as seen under various circumstances, and at various positions of the spectrum, having traced them over several of Fraunhofer's lines.

THEORY OF COMPLEMENTARY COLOURS. BY M. MAUMENE.

The author has described, in a letter to the Paris Academy of Sciences, an experiment which is interesting as regards the demonstration of the Theory of Complementary Colours.

It is well known that the combination of two complementary colours produces white; and this is usually shown in lectures by employing two glasses, one of a red and the other of a green colour, the tints of which, although of considerable intensity, entirely disappear during the simultaneous interposition of the glasses between the eye and the source of light. M. Maumené several years since arrived at the same result by using coloured liquors, and especially by mixing a solution of cobalt with one of nickel, both perfectly pure, and so diluted that their colour is nearly of equal intensity. The rose-red colour of the cobalt is completely destroyed by the green of the nickel, even in concentrated solutions, and the mixed liquid remains colourless.—*Journ. de Pharm. et de Chim.*, Mars, 1850: *Philos. Mag.*, No. 244.

DISTINCT VISION OF RAPIDLY REVOLVING COLOURS.

At the late meeting of the British Association, Prof. Stevelly attempted to explain the occasional Distinct Vision of Rapidly Revolving Coloured Sectors. He exhibited an instrument for whirling cards with coloured sectors on them, devised by Mr. Grattan, of Belfast, to teach his children the effect of combining colours. He had shown this at the Natural History Society, with an application for enabling painters to determine, experimentally, the exact mixture of any number of colours, and their relative proportion to produce the exact effect which they required. This apparatus he had lent to Prof. Stevelly to show his class; and while doing so he was surprised to observe that while the cards were revolving rapidly, if he suddenly turned away his head, he caught a distinct view of the individual coloured sectors at the instant he was losing sight of them by a side view. A few weeks before this he had attended the lectures of Prof. Carlile, of the Queen's College, Belfast, on the anatomy of the eye and of the ear; and had then become acquainted with a fact connected with the arrangement of the optic nerves and their relation to the retina, which seemed to him to afford an explanation of this curious fact. The optic nerve which originated in the right side of the brain crossed over to the left eye, but on entering the eyeball only spread out into that part of the retina which spread over the portion of the eyeball next the nose; and the similar portion of the retina of the right eye was supplied by the optic nerve which sprang from the left side of the brain. These nerves, however, were united in their action by a commissure nerve, which stretched in an arch from the one to the other. The other and larger portion of the retina of each eye, and that on which the images of objects as usually seen were depicted, was formed by nerves which sprang from the brain in each case on the side next the eye to which they went; these, after accompanying the optic nerve of the other eye to the place where it crossed the optic nerve going to its own eye, turned round with a bend and accompanied it in its passage into the eyeball. These portions of the retina of the different eyes were also united into one nervous action by the "commissure of the retina." So that, the retina of each eye was divided into two portions,—the portion next the nose, and the outer and larger portion; and these two portions of each eye were supplied by nerves springing from opposite sides of the brain, and not united in their action by any commissure or connecting nerve. Now, the consequence of the sudden turn of the head was, to throw the image from its usual place on to the portion of the retina next the nose, affecting a new and fresh part of the retina for an instant only, for the motion of the head instantly interposed the socket of the eye and shut off the object. The sectors therefore became distinct at that instant, for a similar reason that in the beautiful experiment of Prof. Wheatstone the electric spark showed them distinct, viz. the instantaneousness of the impression.

Sir D. Brewster said that the crossing of the optic nerves had

been known to Sir Isaac Newton; and a description of the arrangement of the nerves had been found among his papers, and since published. As to the commissure or connecting nerves, he was not so clear about them; but he would consider the entire explanation.

Prof. Forbes said, that as to assisting painters in producing the effect which they might desire by blending of colours by motion, he feared that in some cases this would not answer. For example, he never could by whirling any combination of blue and yellow papers produce a good green, though it was well known that painters by mixing these colours could produce that colour in all its shades.

Sir D. Brewster said the reason of this was, that the blues and yellows of coloured paper were themselves very compound colours, containing usually a very large proportion of red in their composition.—*Athenæum*, No. 1191.

NEW SOLID EYE-PIECE.

THE REV. J. B. READE has stated to the British Association, that he has been able to get rid of the two well-known defects of the common negative Eye-piece, viz., a play of false light and the formation of a false image, or, as it is generally termed, a *ghost* of a planet or star, by simply filling the eye-piece with water. The addition of the water causes the ray of light to pass to the eye without suffering any inner reflexions from the surfaces of the lenses of the eye-piece. It also makes the eye-piece positive instead of negative; while at the same time the magnifying power remains nearly the same,—the magnitude and flatness of the field are preserved,—and the achromatism is not disturbed. It is, however, desirable to make the inner surface of the field lens a little convex, as the ray now passes out of glass into water, and not into air. The Astronomer-Royal of Scotland, after trying the eye-piece upon Saturn, double stars and clusters, expressed a very decided opinion as to its admirable performance generally, as well as on the increased blackness of the field, owing to the absence of all false light. To avoid some little trouble arising from the use of water, the author proposes to substitute glass or rock-crystal for the water, and to cement the surfaces together with Canada balsam; but in this case the inner surfaces of the eye and field lens must have a diminished radius of curvature. It was added that the use of an eye-hole, exactly as in the eye-piece of a Gregorian telescope, is not only desirable, but for large object-glasses indispensable. Without it, the aperture of an object-glass must be reduced to 3 or 4 inches when turned upon the sun, or the dark glasses will infallibly be cracked; but with it, all injurious heat is stopped out, and the full aperture can be used as in the case of a Gregorian of 7 or 8 inches in diameter. This arises from the different refrangibility of the rays of light and heat. In the ordinary use of a prism, it is well known that the rays of heat are less refrangible than the rays of light, and are in fact at a maximum beyond the rays of the spectrum; but when the sun's rays are brought to a focus by means of an achromatic object-glass, the

author finds that the point of most intense heat is within the focus of the compound lens. In a direct experiment with a 6-inch object-glass of Tulley's he found that black glazed paper was not burnt but only smoked when held two inches beyond the focus,—at 1 inch it took fire in 39 seconds,—at half an inch in 27,—at the focus in 24,—at a quarter of an inch *within the focus* in 11,—at half an inch within in 14,—and at 1 inch within in 19 seconds. Hence it follows, from the different positions of the principal foci of light and heat, that the eye-piece which makes the image rays parallel, leaves the hot rays divergent, and passes to some extent on the outside of the illuminating rays; when the eye-hole becomes essentially important, not only for the general purpose of stopping out false light, but particularly for stopping out all injurious heat during the examination of the sun with large telescopes.—*Athenæum*, No. 1191.

CAUSE OF VARIATION IN THE ANGLES OF CRYSTALS.

M. J. Nickles states that the cause is the intervention of foreign substances. In September, 1849, he pointed out this cause in the Variations of the angles of the prisms of sugar of gelatine: and he now adduces a new fact which readily allows of verifying the influence that a small quantity of foreign substances may exert on the crystalline form of bodies which are deposited in its presence. When a solution of chloride of cobalt containing an excess of sal-ammoniac is allowed to evaporate spontaneously, crystals of the last-mentioned salt are obtained which are more or less coloured, the angles of which are always near, but never 90°: the difference often exceeds 7°, and yet these crystals contain only 0·5 to 1 per cent. of chloride of cobalt. The same fact has been observed with respect to crystals of hydrochlorate of ammonia deposited in the presence of bichloride of platina, chloride of nickel, and also with chloride of potassium deposited under similar circumstances.—*L'Institut*, No. 852.

MAGNETO-OPTIC PROPERTIES OF CRYSTALS.

Messrs. Tyndall and Hermann Knoblanch have communicated to the *Philosophical Magazine*, No. 47, a second memoir on the "Magnetio-optic Properties of Crystals, and the Relation of Magnetism and Diamagnetism to Molecular Arrangement." The following are the conclusions:—

In the first section of this memoir it has been proved, by the production of numerous exceptions, that the law of M. Plucker, as newly revised, is untenable. It has also there been shown, that the experiments upon which Mr. Faraday grounds his hypothesis of a purely directive force are referable to quite another cause. In the second section an attempt has been made to connect this cause with crystalline structure, and to prove its sufficiency to produce the particular phænomena exhibited by crystals. In the third section we find the principle entering into the most complicated instances of these phenomena, and reducing them to cases of extreme simplicity. The choice therefore rests between the assumption of *three new*

forces which seem but lamely to execute their mission, and that simple modification of existing forces, to which we have given the name elective polarity, and which seems sufficiently embracing to account for all.

It appears, then, to be sufficiently established, that from the deportment of crystalline bodies in the magnetic field, no direct connexion between light and magnetism can be inferred. A rich possession, as regards physical discovery, seems to be thus snatched away from us ; but the result will be compensatory. That a certain relation exists, with respect to the path chosen by both forces through transparent bodies, must be evident to any one who carefully considers the experiments described in this memoir. The further examination of this deeply interesting subject we defer to another occasion.

Nature acts by general laws, to which the terms great and small are unknown; and it cannot be doubted that the modifications of magnetic force, exhibited by bits of copperas and sugar in the magnetic field, display themselves on a large scale in the crust of the earth itself. A lump of stratified grit exhibits elective polarity. It is magnetic, but will set its planes of stratification from pole to pole, though it should be twice as long in the direction at right angles to these planes. A new element appears thus to enter our speculations as to the position of the magnetic poles of our planet ; the influence of stratification and plutonic disturbance upon the magnetic and electric forces.

EFFECTS OF LIGHTNING ON A TREE.

THE "Report of a Committee appointed to examine the Effects produced by Lightning on a Tree near Edinburgh," by Prof. Phillips, has been read to the British Association. The tree in question stands in the grounds of Mr. Wauchope, at Edmonstone, about four miles from Edinburgh, on the Dalkeith road. The surface slopes gently to the north; the substrata are part of the coal formation, and contain at a small depth an abundance of the rich "black band" ironstone. The locality appears remarkably liable to lightning strokes; several other trees having been destroyed there since 1834. The tree examined by the Committee was struck on the 11th of June, 1849, on a still, sultry day. It was an oak tree. It stood in rather a clear space—the surrounding trees being chestnut, elm, &c. It was a large tree (14 feet in girth), but there were others as high and of rather greater diameter. When struck it was full of sap. The mechanical effects of the lightning were violent. The main trunk of the tree, which appears to have stood about twelve feet high before sending off branches, was rent from top to bottom; some of the branches were broken off; all were thrown down and implicated together, and for some distance upward fissured and twisted: some of the roots were split for a yard or more from the stem. A large mass from the northern side of the tree was driven out, and carried through the air 127 feet, in the direction of the

magnetic meridian to N.N.W. Its weight was $2\frac{1}{2}$ cwt. The main stem was entirely denuded of the bark, which was scattered widely around, but most abundantly in a direction opposite to that in which the log of wood was conveyed. Shreds of wood were carried to the north-west, and left hanging in the trees. What remained standing of the stem, as well as the parts which had been displaced, was cleft into wedges, by vertical radiating fissures parallel to the laminæ of medullary rays; and these wedges were again cleft by other vertical fissures concentric to the axis of the tree and coinciding with the annual bands of large vertical vessels which are conspicuous in cross sections of the oak. Where these cleavages produced the fullest effect, the wood was divided into long slender prismatic shreds like lucifer matches. The smaller split masses were much twisted. For all these phenomena a simple mechanical cause appears sufficient: viz., an internal expansion and bursting of the main stem of the tree along the surfaces, which by the structure of the tree admitted of the most easy separation, and contained at the time abundance of liquid sap capable of assuming the form and force of elastic vapour. Hence, in the first place, the destruction of the main stem by explosion, the projection of the bark and woody fragments, and the minute and regular cleavage of the fibres. The stem being destroyed as a support, the branches fell in ruinous aggregation round it. It appears that a laburnum tree, situated about twelve yards to the east, had been twice struck by lightning; first (believed) in 1834, and again in 1844. It was split, but not barked. An elm situated about 100 yards to the north was struck, and in a like manner split, but not barked. These differences may perhaps be due to the difference of structure in the wood; but in all cases before attempting to explain the phenomena observed as the effects of lightning, it is desirable to be informed of the times of year when the trees were struck. The precise points of entrance and exit of the lightning cannot be stated. A small quantity of black powder was found in the fissured part of the wood, at the base of the twisted branches; but nothing was observed which could determine the course or the chemical effects of the electrical agent.*—*Athenæum*, No. 1190.

DEATH BY LIGHTNING.

A WRITER in the *Journal of Commerce* says:—I examined a dwelling-house between Farmingdale and Amityville, L. I., which was struck by lightning at ten minutes past two A.M., of Monday, July 29. The clock in the house was stopped by the lightning, and its iron works converted to magnets. The building is of wood, one and a half story high; in the attic is a cooking-stove, standing on a sheet of zinc. The lightning entered the chimney, and followed the stove pipe to the stove, and thence to the zinc. There it divided and parted off in various directions, knocking off the fastenings of the ceiling underneath. On one side, on the floor, was a bed, in which two boys were sleeping. The lightning struck one of the

* Since the Report was presented, Mr. Wauchope has cleared a larger portion of the roots, and has found them split and *blackened* considerably.

boys, of six years of age, killing him instantly. A hole was made in his head by the lightning of the size of a musket ball. The other boy was not at all affected. On the opposite side of the room Mr. Bedell, his wife, and an infant child slept, also in a bed on the floor. Mr. B. rose when the storm came on, and lighted a candle, which the lightning extinguished when it entered the house. Mrs. B. was struck by the lightning, and rendered insensible for some time. The lightning passed over her body, and down the whole of one of her lower limbs, drawing a bright red line the whole distance it passed over the skin ; and near her ankle are several large blotches, which were very painful. The babe had several large blotches upon it, which were very much inflamed. The child was stupid for two or three hours, and then commenced crying, and continued several hours. The lightning entered the lower room, and broke a looking-glass to atoms. It made several round holes, about the size of musket balls, in the walls and plastering. Had the persons sleeping on the floor been on a bedstead, they would have probably escaped, as the lightning would not have risen from the zinc sheet on the floor to disturb them.

GLASS AS A NON-CONDUCTOR.

Mahanama, who wrote his history before A.D. 477, mentions that Sanghatissa, King of Ceylon (who was poisoned A.D. 246), placed a pinnacle of Glass on the spire of Ruanwelli Dagoba, "to serve as a protection against lightning." This shows that the Cingalese were then aware that glass was a Non-conductor of the electric fluid. (*From Forbes' Recent Disturbances and Military Executions in Ceylon*, p. 51. Blackwood, 1850.)—*Sir W. C. Trevelyan.*

INSTRUMENTS FOR THE MEASUREMENT OF EARTHQUAKE WAVES.

Mr. Mallet has reported provisionally to the British Association, that the Committee had examined one branch of the subject with the aid of the new Seismometer, and had arrived at unexpected and important results. This branch was the effect of concussions propagated through beds of sand, earth, &c. They proposed communicating these results in a full report as soon as they had examined the transmissions of concussions through rocks. The former concussions they had produced by exploding gunpowder ; these they proposed producing by the blow of a heavy mass of matter descending on the rock.—*Athenæum*, No. 1190.

HAIL-STORMS IN INDIA.

Col. Sykes has described to the British Association, several Storms of Hail which have occurred in India, the details collected from various sources by Dr. Buist. The weight of some masses of ice was over 14 lbs. Many of them, under a rough external coat, contained clear ice within, and with that peculiar radiated structure which he had elsewhere described. Immense aggregated masses of these great hailstones were in some places brought down from the

mountain ravines by the succeeding torrents, and in one of these conglomerations a snake was found frozen up and apparently dead; but it soon thawed and revived.

THE SIX CLIMATES OF FRANCE.

Dr. Martins has stated to the British Association, that France partakes of the climates both of continental and sea-girt countries. He considered six climatorial subdivisions, viz.—1. The North-east or Vosgien.—2. The North-west or Séquanien.—3. That of the West or Armorician.—4. The South-west or Girondin.—5. The South-east or Rhodanien.—6, and finally, the Mediterranean or Provençal climate. Upon each of these subdivisions he enlarged; detailing the features of the country, the rivers, mountain-ranges, sea-coasts, geological structure, differences of level, and state of cultivation in each case, with the prevailing and most important features in the actual climate of each. Dr. Martins exhibited a map of France with these six regions distinguished. He stated, that hitherto the labours of the meteorologists of France had no channel of publicity at their command, but that a journal devoted exclusively to Meteorology was about to be established.

FREEZING WATER.

Mr. Faraday has read to the Royal Institution, a paper "On certain Conditions of Freezing Water." The chief object of Mr. Faraday's discourse was the great, various, and extraordinary forms of affinity which exist between the particles of water. Having experimentally illustrated the combining power of water, and shown how this attraction passes from a physical to a chemical force, Mr. Faraday confined the rest of his discourse to ice, as being that condition of water in which its particles are allowed to associate with each other without the intervention of foreign matter. Such ice as is now imported into this country under the name of the Wenham Lake ice (though it is chiefly supplied from Norway) may be regarded as one of the purest natural substances. Mr. Faraday first showed how entirely colouring matter, salts, and alkalies, are expelled in freezing. A solution of sulphate of indigo, diluted sulphuric acid, and diluted ammonia, were partially frozen in glass test-tubes: as soon as the operation had been carried on long enough to produce an icy lining of each tube, the unfrozen liquid was poured out and the ice dislodged. This ice was found in every instance perfectly colourless; and, when dissolved, perfectly free from acid or alkali; although the unfrozen liquid exhibited in the first experiment a more intense blue colour, in the second a stronger acid, and in the third a more powerful alkaline reaction than the liquor which was put into the freezing mixture. Mr. Faraday also devised a method for making this ice perfectly clear and transparent as well as colourless. By continually stirring the liquid, while freezing, with a feather, he brushed away globules of air as fast as they were dislodged from the freezing liquid, and thus pre-

vented their becoming imbedded in the ice. Having noticed the rapidity with which water absorbs air as soon as it is thawed, Mr. Faraday called attention to the importance of this natural arrangement to aquatic plants and animals, to whose life air is as indispensable as to those which live on land. Mr. Faraday then referred to Mr. Douny's discovery that water, when deprived of air, does not boil till it reaches the temperature of 270°; and that, at that degree of heat, it explodes. He mentioned that he suggested to Mr. Douny that ice when placed in oil (so as to prevent its receiving any air from the atmosphere on thawing) would probably explode on reaching the boiling temperature. This experiment had been successfully tried by Mr. Douny, and was as successfully repeated on this occasion. Mr. Faraday then invited attention to the extraordinary property of ice in solidifying water which is in contact with it. Two pieces of moist ice will consolidate into one. Hence the property of damp snow to become compacted into a snowball—an effect which cannot be produced on dry, hard frozen snow. Mr. Faraday suggested, and illustrated by a diagram, that a film of water must possess the property of freezing when placed between two sets of icy particles, though it will not be affected by a single set of particles. Certain solid substances, as flannel, will also freeze to an icy surface, though other substances, as gold-leaf, cannot be made to do so. In this freezing action latent heat becames sensible heat; the contiguous particles must therefore be raised in temperature while the freezing water is between them. It follows from hence, that, by virtue of the solidifying power at the points of contact, the same mass may be freezing and thawing at the same moment, and even that the freezing process in the inside may be a thawing process on the outside. Mr. Faraday then referred to Mr. Thomson's memoirs on the effect of pressure on the freezing point. Mr. Thomson has shown that immense pressure will prevent water from freezing at 32°—ice naturally occupying a greater volume than that of the water which forms it. And we may conceive that when ice is pressed, the tendency is to give both the water bulk and state.

In conclusion, Mr. Faraday noticed briefly, and chiefly by way of suggestion, the molecular condition of ice as presenting many curious results; and called attention to the strangeness of striæ being formed in a body of such uniform composition as pure water frozen into ice.

MAKING ICE.

We quote the following from the *Athenæum*, No. 1158 :—

"Collingwood, Dec. 24.

"Without wishing to detract from the merits, or in any way to interfere with the claims of Dr. Gorrie, of Florida, in relation to his process for making ice by the expansion of highly compressed air (previously reduced to the ordinary temperature), as described in your *Athenæum* of Saturday the 15th inst., I could wish to place

on record, as a matter of scientific history, that on more than one occasion within the last four or five years I have explained orally to friends a process identical in principle, *as practically applicable to the manufacture of ice for sale on the great scale;* the only question being that of remunerative cost as compared with that of importation.

"The annexed note, which I have received from my valued friend Mr. May, will bear me out in this statement, so far back as February 11, 1848: long prior to which, were it worth while, I could cite other testimony.

"I am, &c. J. F. W. HERSCHEL.

"P.S.—An old steam-boiler, buried some 20 or 30 feet under ground in well rammed earth, and furnished with a condensing pump (worked above ground), and one eduction pipe opening by a stop-cock through a rose into water, would in all probability supply ice *ad libitum* for the use of a family in the country; the condensation being performed over night."

"Ipswich, 12 mo. 20th, 1849.

"Dear Friend,—I have a very clear recollection of our conversation on the subject of forming ice and cooling water for drinking purposes, and of thy suggesting that advantage might be taken of the reabsorption of heat, by the expansion of condensed air that had been cooled to ordinary temperature in its compressed state.

"We agreed as to the possibility of its being done, but the probable cost appeared to me a difficulty in bringing it into practice.

"This conversation took place either at the anniversary dinner of the Royal Astronomical Society, in the early part of 1848, or at the Greenwich visitation a few weeks afterwards; but I think it was at the former. [It was so].

"Believe me, thine very truly,

"(Signed) CHARLES MAY.

"Sir J. F. W. Herschel, Bart.

"P.S.—Whilst discussing this question, I remember repeating an account of a little experiment I made when a boy with one of Newman's condensed air-vessels—then just introduced for blowpipes. I had an idea that if a stream of condensed air were suddenly thrown upon sulphur, it would inflame the latter. Accordingly, a vessel was filled with air almost to the limit of safety, and a roll of sulphur cautiously held to be ready for the opening of the stopcock; when, lo! instead of inflaming the sulphur, a small cone of ice was formed! This was in 1816 or 1817."

[The Chemnitz fountain has long since settled the practicability of so producing ice. The useful application of the principle is the point in question.—H.]*

THE KEW OBSERVATORY.

MR. F. RONALDS has communicated to the British Association,—

* Dr. Goorie's Invention is noticed in the *Year-Book of Facts*, 1850, p. 127.

his Report on the "Observations and Experiments at the Kew Observatory."

This Report, which was voluminous and elaborate, detailed the arrangements of the buildings, and the improvements which had taken place during the last year; the instruments, and the peculiarities of their construction and late improvements, the most important of which was that, by the use of transparent gelatine paper, a light line could be etched on it exactly corresponding with the curve traced by any of the self-registering instruments, which piece of gelatine paper being then sent to the copperplate printer, he was able to strike off from it any number of copies that might be required for distribution. Prof. Phillips then gave a sketch of the observations which had been established under the unpaid and invaluable superintendence of Mr. Ronalds since 1842-3, when the Observatory was placed by Government at the disposal of the British Association. He gave a brief description of the manner in which a piece of photographic paper, being carried by clock-work across the direction in which the instrument moved whose changes were to be noted, received a succession of impressions which appeared as a curved line, recording the several indications of the instrument as the time elapsed. Sir D. Brewster wished to suggest to Mr. Ronalds that by taking a negative impression of the positive photographic curve, copies might in a much simpler manner be multiplied to any extent, —as was now practised in Edinburgh; and he promised to exhibit specimens on some future occasion to the Section.

NEW ANEMOMETER.

Mr. F. Osler has communicated to the British Association, a notice of the "Working of the New Integrating Anemometer during the past year." A sheet of *plain paper* placed in the instrument under a registering pencil is moved forward by rotating hemispherical fans, at the rate of one inch for every ten miles of air that passes; this same pencil, having a lateral motion given to it by a vane, records the point of the compass from which the wind blows, and a clock hammer descending every hour strikes its mark on the margin of the paper to express the time. Thus, in a *single line*, are given, firstly, the length of the current; secondly, the direction of it; and thirdly, the time occupied in passing a given station marked hourly or at any shorter interval that may be desired.

THE DYNACTINOMETER.

Mr. Claudet has described this instrument to the British Association. Introductorily, he insisted on the great importance of distinguishing between the optical foci of the photogenic rays. He said that ignorance of this distinction, or inattention to it, was the source of one of the greatest defects in photographic pictures. He had invented a simple instrument, which was exhibited and explained, for accurately distancing the object to be depicted and de-

termining the corresponding foci of the photogenic rays, in any given camera. It consisted of a number of marked sectors arranged in a spiral order at several equal distances along a cylinder supported in a frame. By placing this before a photographic camera, the sector of which the image was most distinct could be at once seen, and this determined the distance at which the object should be placed in front of the camera. Since he had invented this, he had found that there was a proper time for exposing an object on a given day, and under given circumstances, before the camera; and that a longer or a shorter time than this was injurious to the effect. To ascertain readily this proper time, he had invented the Dynactinometer, which he now exhibited. It consisted of a square frame of card, with a circle of card capable of being turned round either by hand or by clock-work; in one position of this circle the whole surface of the frame exposed to the camera at the proper photogenic distance was black; but as the circle turned, a neatly divided sector of white card was exposed, and by causing the circle to turn so as to expose a given number of divisions each successive equal number of seconds, the part of the sector whose image was most clearly defined on examination of the photogenic drawing gave the number of seconds best for exposing the object to the camera. But as the several photogenic plates were not all equally sensitive, the sensitiveness of the plates was determined by placing them in a small frame, and allowing them to descend along an inclined plane, during a certain part of which descent small circular spots were exposed to the action of light, the rest being quite protected. The action of the light on these spots gave a ready and exact means of comparing the sensitiveness of the several plates.

REMARKABLE PROPERTY OF STEAM CONNECTED WITH THE THEORY OF THE STEAM-ENGINE.

MR. J. P. JOULE, F.R.S., has communicated to the *Philosophical Magazine*, No. 251, a letter from Prof. W. Thomson, containing an explanation of the true cause of the non-scalding property of Steam issuing from a high-pressure boiler. The proposition (announced by Mr. Rankine) is certainly one of very great importance; as it would appear from it that when saturated steam is allowed to expand so as to evolve work, a part of it is condensed, and that this condensation affords heat for the expansion of the remainder of the steam. This fact, which is analogous to that of the production of a cloud when air saturated with vapour is rarefied in the receiver of an air-pump, explains the approach of the economical duty of the steam-engine to that of the air-engine.

PNEUMATIC SPHEROIDAL ENGINE.

THE attention of the Continental engineers has again been called to the Pneumato-Spheroidal Engine of M. Testud de Beauregard. It will be remembered that this engine is constructed on the principle so ably investigated by M. Boutigny, of employing water

in the spheroidal state: this condition being induced by allowing it to drop into heated metal tubes. Although the water never acquires the boiling temperature, the vapour escaping from it has the high temperature of the metal with which it was in contact, and is therefore in the highest state of tension. An engine of this construction has been at work for some months in the atelier, 162, Faubourg Saint-Denis, and it is said to act exceedingly well, and to be very economical.—*Athenæum*, No. 1160.

Professor Plücker, of Bonn, has communicated to Poggendorff's *Annalen*, the following observations upon M. Boutigny's experiment:—

"Whilst admiring M. Boutigny's rare perseverance in following up a fertile idea, (says Professor Plücker), I acquired an impression that it referred to a law of nature by no means completely revealed, and in which I was further strengthened by the report of his last experiment. In consequence of an oral communication of this experiment, M. Fessel wrote to me from Cologne, stating that on the following day he had dipped his finger into lead heated to its highest point, by which means the projecting portion of the nail of the finger had been burnt, but in other respects the finger remained perfectly uninjured; he also stated further, that a workman in the employ of Messrs. Behren and Co., manufacturing engineers at Cologne, had made the experiment with melted iron, and would repeat it before me. I therefore accepted the offer, and, accompanied by several persons interested in the matter, proceeded to Cologne. The workman in my presence struck the unmoistened extremities of his fingers rapidly and not without fear against the surface of the iron, which had just flowed from the melting furnace into a trough, and which was afterwards used in casting a large plate for a furnace. I was thus convinced of the perfect truth of Boutigny's experiment; and whilst carefully examining the extremities of the workman's fingers, one of the two assistants of the Physical Cabinet accompanying me struck the entire surface of the open hand, which he had previously dipped in water, so strongly against the bright red surface of the iron, that some of the fused metal was ejected; the other assistant immediately afterwards also struck it with his moistened hand. After these experiments, which were made in opposition to Boutigny's precautions not to strike the mass, experiments which for the sake of precaution I wished to make before the immersion, became unnecessary; I moistened my right hand, inserted the index finger almost completely into the melted mass, and moving it very slowly through it, withdrew it in two seconds: at the same time I felt how the iron moved before my finger, but *did not experience the slightest* sensation of heat.*

* More than twenty years ago, Prof. H. Rose, in visiting the foundries at Avestad in Sweden, saw a workman, for a small reward, take melted copper with the bare hand from a crucible and throw it against the wall. This confirms his statement, as also some other facts which Boutigny himself mentions in his memoir, that the phenomenon mentioned has long been known, especially among people engaged in the arts.—Poggendorff.

"I should have considered the temperature of the iron, which was about 2732° F., as below 96° F.; for on withdrawing the finger, it was not so warm as the other hand. M. Fessel also, and the other three persons who accompanied me, repeated this experiment with certain modifications: one of them with his hand dry; another remarked that the hand, after having been previously dipped in water, when withdrawn was only dry in that part which had not been immersed; a third took up the iron with the hand made hollow. The minute hairs upon the inserted fingers had entirely disappeared; but the nails were not injured, nor was any penetration of heat through the nails remarked. The hand when withdrawn had a slight empyreumatic odour, which was stronger when there were warts upon it; but in no case was there the slightest burning sensation, or even a disagreeable sensation of heat. Hence certain minor operations in surgery might be performed with least pain by placing the foot in a bath of red-hot iron. Lastly, I made one other experiment, the result of which might have been anticipated.

"I held the finger of a leathern glove, which I had well wetted inside and had placed on a wooden rod, for nearly a minute in the melted iron; on withdrawing it, the glove was not only unburnt, but had only a temperature of about 132° F. (I had not a thermometer with me). Conjectures and theoretical views upon these remarkable phænomena would be premature without further experiments. I hope, however, soon to be able to communicate some remarks upon them."—See *Philosophical Magazine*, No. 241.

M. Boutigny has devised an exceedingly simple method for showing his interesting experiments on the spheroidal state of fluids. He takes a platinum wire, and rolls it into a spiral like the spring of a watch, taking care to depress the central portion. He thus forms a sort of capsule, or circular and concave gridiron, in which the water is contained when the wire has been previously made red-hot. By the repulsion of caloric, the water is retained, and forming itself into a spheroid, rolls about without flowing through. Alcohol or ether may be substituted for water; when the vapours escaping, take fire above and below the wire,—but the spheroidal drop moves rapidly about within the flames without undergoing combustion.—*Athenæum*, No. 1196.

ON IMPACT ON ELASTIC BEAMS. BY HOMERSHAM COX, B.A.

Among the experiments instituted by the Royal Commission appointed to inquire respecting the use of iron in railway structure, was a series relating to Impact on Beams. These experiments were undertaken by Professor Hodgkinson, and were conducted in the following manner. The two ends of the beam were fixed in a horizontal position, and the blow was given against one of its vertical sides in a horizontal direction. The instrument for giving the blow was a heavy iron ball, hanging down, when at rest, from a point of suspension vertically above the centre of the beam. The ball was

raised through different arcs, and after descending its own gravity, struck the beam. The deflection corresponding to different arcs of descent was carefully noted by a graduated scale.

The object of the present paper is to show that the results might have been predicted by known theoretical principles with considerable precision and confidence. The problem is divided into two parts: 1st, to estimate the amount of velocity lost by the ball at the first instant of collision; 2d, to ascertain the effect of the elastic forces of the beam in destroying the *vis viva* which the whole system has immediately after collision. In the first part of the investigation, a general formula, derived from the combination of D'Alembert's principle and that of virtual velocities, is given for the motion of any material system subject to impact. The requisite geometrical condition required for the application of this general formula to the present case is obtained by the assumption, that immediately after impact the form of the beam is a gradual and tolerably uniform curve: such as, for example, the elastic curve of equilibrium. In this way it is determined that about one-half the inertia of the beam is effectively applied at the instant of collision to retard the ball.

The *vis viva* of the whole system thus computed is destroyed by the elastic forces of the beam developed by deflection. These, in the second part of the problem, are assumed to vary as the amount of central deflection. By the principle of *vis viva* a formula is easily obtained, connecting the amount of total deflection with the *vis viva* of the system immediately after collision.

Tables are given in which the theoretical and experimental results are compared. The correspondence is of the closest and most satisfactory nature. Indeed, the theoretical result generally differs less from the mean of several experiments than those experiments differ among themselves. Both in the theoretical and experimental inquiries, every possible variation of the elements of the investigation —the relative masses of the beam and ball—the velocity of the latter—the rigidity and dimensions of the former—have been included.—*Proceedings of the Cambridge Philosophical Society.*

TENACITY OF METALS.

As the results of numerous experiments, M. Baudrimont has arrived at the following conclusions:—

1. That the tenacity of metals varies with their temperature.

2. That it generally decreases, though not without exception, as the temperature rises.

3. That with silver the tenacity diminishes more rapidly than the temperature.

4. That with copper, gold, platina, and palladium, it decreases less rapidly than the temperature.

5. That iron presents a very peculiar and remarkable case: at 212° F. its tenacity is less than at 32°: but at 392° its tenacity is greater than at 32°.—*Comptes Rendus.*

DIFFUSION OF LIQUIDS.

On December 21, 1849, the Bakerian Lecture was delivered to the Royal Society, by Professor Graham, F.R.S., "On the Diffusion of Liquids." In conclusion, it was observed, that it is the diffusion molecules of the salts which are concerned in solubility, and not the Daltonian atoms or equivalents of chemical combination; and the application was indicated of the knowledge of the diffusibilities of different substances to a proper study of endosmose.

METALS IN SEA-WATER.

MM. Malaguti, Durocher, and Sarzeaud, announce that they have detected in the waters of the ocean the presence of copper, lead, and silver. The water examined appears to have been taken some leagues off the coast of St. Malo, and the fucoidal plants of that district are also found to contain silver. The *F. serratus* and the *F. ceramoides* yielded ashes containing 1-100000th, while the water of the sea contained but little more than 1-100000000th. They state also that they find silver in sea salt, in ordinary muriatic acid, and in the soda of commerce; and that they have examined the rock salt of Lorraine, in which also they discover this metal. Beyond this, pursuing their researches on terrestrial plants, they have obtained such indications as leave no doubt of the existence of silver in vegetable tissues. Lead is said to be always found in the ashes of marine plants, usually about an 18-1000000th part, and invariably a trace of copper. Should these results be confirmed by further examination, we shall have advanced considerably towards a knowledge of the phenomena of the formation of mineral veins.—*Athenæum*, No. 1160.

PRESENCE OF ORGANIC MATTER IN WATER.

The following facts relative to the Presence of Organic Matter in Water have been presented to the British Association, by Prof. Forchhamer, as the result of observations on water, near Copenhagen.

1st. The quantity of organic matter in water is greatest in summer. 2d. It disappears, for the most part, as soon as the water freezes. 3d. Its quantity is diminished by rain. 4th. Its quantity is diminished if the water has to run a long way in open channels. The hypermanganate of potash or soda is recommended by the Professor as an excellent test for the presence of organic matter in water.

FIXATION OF NITROGEN.

Dr. Wollaston examined the cubic crystals obtained from the slags of iron blast furnaces, and regarded them as metallic titanium. M. Wohler has analyzed these crystals; and has proved that they are formed of a cyanide and nitruret of titanium, containing 18 per cent. of nitrogen and 4 per cent. of carbon. The titanium obtained by M. Rose is also shown to be a nitruret of that metal, containing

28 per cent. of nitrogen. These results go to prove that nitrogen may be fixed at the high temperatures of an iron blast furnace; a fact which has not hitherto been even suspected.—*Athenæum*, No. 1158.

GEOGRAPHICAL DISTRIBUTION OF ANIMALS.

PROFESSOR LOUIS AGASSIZ has communicated to an American periodical, a paper on this subject, which he concludes as follows:—"We are thus led to distinguish special provinces in the natural distribution of animals, and we may adopt the following division as the most natural: *first*, the *arctic province*, with prevailing uniformity. *Second*, the temperate zone, with at least three distinct zoological provinces—the *European temperate zone*, west of the Weal Mountains, the *Asiatic temperate zone* east of the Ural Mountains, and the *American temperate zone*, which may be subdivided into two, the *eastern* and the *western*—for the animals east and west of the Rocky Mountains differ sufficiently to constitute two distinct zoological provinces. Next, the tropical zone, containing the *African zoological province*, which extends over the main part of the African continent, including all the country south of the Atlas and north of the Cape Colonies; the *tropical Asiatic province*, south of the great Himalayan chain, and including the Sunda Islands, whose *Fauna* has quite a continental character, and differs entirely from that of the Islands of the Pacific, as well as from that of New Holland; the *American tropical province*, including Central America, the West Indies, and tropical South America. *New Holland* constitutes in itself a special province, notwithstanding the great differences of its northern and southern climate, the animals of the whole continent preserving throughout their peculiar typical character. But it were a mistake to conceive that the *Faunæ* or natural groups of animals are to be limited according to the boundaries of the mainland. On the contrary, we may trace their natural limits into the ocean, and refer to the temperate European *Fauna* the eastern shores of the Atlantic, as we refer its western shores to the American temperate *Fauna*. Again, the eastern shores of the Pacific belong to the western American *Fauna*, as the western Pacific shores belong to the Asiatic *Fauna*. In the Atlantic Ocean there is no purely oceanic *Fauna* to be distinguished; but in the *Pacific* we have such a *Fauna*, entirely marine in its main character, though interspread with innumerable islands extending east of the Sunda Islands and New Holland to the Western shores of tropical America. The islands west of this continent seem, indeed, to have very slight relations in their zoological character with the western parts of the mainland. South of the tropical zone we have the *South American temperate Fauna*, and that of the *Cape of Good Hope*, as other distinct zoological provinces. Van Diemen's Land, however, does not constitute a zoological province in itself, but belongs to the province of New Holland, by its zoological character. Finally, the antarctic circle encloses a special zoological province, including the *antarctic Fauna*,

which, in a great measure, corresponds to the arctic *Fauna* in its uniformity; though it differs from it in having chiefly a maritime character, while the arctic *Fauna* has an almost entirely continental aspect.

The fact that the principal races of man, in their natural distribution, cover the same extent of ground as the great zoological provinces, would go far to show that the differences which we notice between them are also primitive; but for the present we shall abstain from further details upon a subject involving so difficult problems as the question of the unity or plurality of origin of the human family, satisfied as we are to have shown that animals, at least, did not originate from a common centre, nor from single pairs, but according to the laws which at present still regulate their existence.

Professor Agassiz's new views will be found entire in *Jameson's Journal*, No. 97.

SIZE OF THE HUMAN BRAIN.

Dr. Samuel George Morton has communicated to the Academy of Natural Sciences of Philadelphia, certain observations on the Size of the Brain in various Races and Families of Man; the results of the internal measurements of 623 human crania, made with a view to ascertain the relative size of the brain in various races and families of Man.

Among the facts elicited by this investigation are the following:—

1. The Teutonic or German race, embracing as it does the Anglo-Saxons, Anglo-Americans, Anglo-Irish, &c., possess the largest brain of any other people.

2. The nations having the smallest heads are the ancient Peruvians and Australians.

3. The barbarous tribes of America possess a much larger brain than the demi-civilized Peruvians or Mexicans.

4. The ancient Egyptians, whose civilization antedates that of all other people, and whose country has been justly called "the cradle of the arts and sciences," have the least-sized brain of any Caucasian nation, excepting the Hindoos; for the small number of Semitic heads will hardly permit them to be admitted into the comparison.

5. The Negro brain is nine cubic inches less than the Teutonic, and three cubic inches larger than the ancient Egyptian.

9. The largest brain in the series is that of a Dutch gentleman, and gives 114 cubic inches; the smallest head is an old Peruvian, of 58 cubic inches; and the difference between these two extremes is no less than 56 cubic inches.

7. The brain of the Australian and Hottentot fall far below the Negro, and measures precisely the same as the ancient Peruvian.

8. This extended series of measurements fully confirms the fact stated by me in the *Crania Americana*, that the various artificial modes of distorting the cranium occasion no diminution of its internal capacity, and consequently do not affect the size of the brain.

Sir William Hamilton, in a paper communicated to *Jameson's*

Journal, No. 96, objects to Dr. Morton's conclusions; adding that he (Sir W. H.), has now "established, apart from the proof by averages, *that the human encephalon does not increase after the age of seven, at highest.* This has been done, by measuring the heads of the same young persons, from infancy to adolescence and maturity; for the slight increase in the size of the head, after seven (or six), is exhausted by the development to be allowed in the bones, muscles, integuments, and hair."

NEW MEMBRANE INVESTING THE CRYSTALLINE LENS.

At the late meeting of the British Association, Sir D. Brewster drew a diagram representing the Crystalline Lens of an ox with its investing capsule; and said that having lately had occasion to examine the crystalline lens of an ox, which had been killed the day before, he had put it into water,—by imbibing which it had soon swelled, and at length the capsule burst. Before it had burst, however, he had observed distinctly a membrane not before recognised by anatomists, which had at one part detached itself from the body of the lens which it manifestly invested, and risen up within and towards the capsule at one spot.

CRETINISM.

It appears from the Report of a Commission appointed by the King of Sardinia to ascertain the amount of Cretinism in that kingdom, that out of the total population of the Sardinian States the number of cretins is 0·27 per cent., and those having goitres is 0·82 per cent. It was M. Saussure's opinion that cretinism did not exist in places 1,000 metres, or 3,280 English feet, above the level of the sea: but this is entirely disproved by the Commissioners,—who found numerous cases of cretinism in localities elevated 1,600 metres, or 5,248 feet above the sea. Indeed, in one village possessing this elevation, 90 cases of goitre and cretinism were found in every 1,000 of the population.—*Athenæum*, No. 1185.

ON A TISSUE WOVEN BY CATERPILLARS, BY MR. DENNISTOUN.

In the early part of this century there lived at Munich a retired officer, Lieut. Hebenstrait, who amused himself by experiments on the means of giving consistency to the gossamer produced by Caterpillars, which is occasionally seen blown about in flakes over the fields in Germany; and he was at one time sanguine of rendering it available as a material for ladies' dress. It is said that his plan was to prepare a paste of lettuce or other leaves beat up with butter; and, after spreading it thinly over a smooth surface of stone or wood on an inclined plane, he placed at the lower end a number of chenilles or caterpillars of the proper species. These animals gradually ascended the incline, devouring the paste, and depositing as they proceed a sort of tissue until the whole surface was uniformly covered with it. He is reported to have produced open work designs by drawing the pattern with a hair-pencil dipped in olive oil

before the animals begin to work. These I never saw, but I have seen one veil on which were some letters exactly resembling a water-mark on paper, the secret of which I do not know. The inventor pursued his experiments with great secresy, in the hope of turning his invention to valuable account; but finding this impracticable, it appears that he produced but very few specimens, which are now preserved in various museums on the Continent. I have seen two besides my own, which I procured at Munich, in 1837, after having advertised for it several months. My veil is about 42 inches by 24 inches. One of 26½ inches by 17 inches is said to have weighed only 1½ grain. Another containing 9 square feet is mentioned as weighing 4⅓ grains, while the same surface of silk gauze weighed 137 grains, and of fine lace 262½ grains. It would seem that the art was in some degree known at an earlier period, and occasionally practised in convents, where coloured drawings on small bits of it are said to have been made. I have seen, in all, four of these on the Continent, and two or three on which impressions from copper plate had been taken,—always of sacred subjects. One of the drawings is in my possession, about 7 inches by 5 inches, executed apparently in the last century, and I have seen one dated about 1770.

This beautiful tissue is rather more transparent than the finest lace veil, but it floats about with every slight current in the air of a room, after a manner quite its own.—*Proceedings of the British Association*, 1850.*

LARGE MAGNET, BY ELIAS.

A MAGNET, made by Mr. Elias, of Haarlem, has been presented to Mr. Faraday, by Mr. Logeman, of that city. It weighs 0·98 lb. and lifts 26 lb.; and its power is not diminished on the keeper being forced abruptly from the poles, even though this be done many times in succession. Haecker's formula fixes the greatest sustaining power of the best artificial steel magnets at $10{\cdot}33\ N^{\frac{2}{3}}$ (N being the weight of the magnet): and this magnet has twice the power expressed by that formula; and even when a disc of letter-paper is interposed between the poles and the keeper, it will sustain the weight indicated by this formula. The small horseshoe magnet belonging to the Royal Institution weighs 7 lb. 14½ oz., and lifts from 40 to 41 lb. (*i. e.* nearly $10{\cdot}33\ N^{\frac{2}{3}}$). This magnet of Mr. Elias would support its own weight at a single pole; and in this property it resembles the cylindrical bar-magnets now made in the electro-magnetic helix, and used in the magnetical observatories. Probably this horseshoe magnet of Mr. Elias might be charged by a similar process.

* This curious fabric is noticed in our *Arcana of Science and Art* for 1829, page 145.—ED. *Year-Book of Facts.*

Electrical Science.

EXPERIMENTAL RESEARCHES IN ELECTRICITY. BY MR. FARADAY.

THE twenty-third series of these Researches has been communicated to the Royal Society. § 29. On the Polar or other condition of Diamagnetic Bodies. The author, whilst developing, on a former occasion, the phenomena of diamagnetic action, said that all the results might be accounted for by assuming that bismuth, phosphorus, &c. when in the magnetic field, became polar as iron is polar, but with the poles in the contrary direction. This view has since then been adopted by Weber and others, and supported by certain experimental results. In the present paper these results and that view are brought under very close examination. An apparatus was constructed by which a cylinder of any given metal could be moved to and fro through about 2 in. in the direction of its axis. In doing this it approached close up to, and then retreated from, the pole of an electro-magnet, and also moved within a helix of covered wire which was fixed in relation to the magnet. Now, the action of such a piece of metal upon the helix is very different in theory and also in reality, according as it is dependent upon a polarity, magnetic or diamagnetic, acquired by the metal, or upon induced currents existing in the mass; and the question was to ascertain by experiment whether the latter were the cause of the results obtained by Weber and others. The various diamagnetic metals gave the results looked for at the indicating galvanometer; but then these were almost insensible with bismuth, and were greatest with gold, silver, copper; the better conductors being, indeed, in proportion to the conducting power. Such results were in favour of induced currents rather than of polarity. *Division* was next resorted to as a distinguishing test of the polar or current action: thus a cylinder made up of lengths of wires acted as well as a solid cylinder, if the metal were one acquiring a polar state, as iron; but such a division interfered with the existence of induced currents in the mass, and it was found that such wire cylinders of copper, &c. lost all power. On the other hand, division of the cylinder into innumerable discs interfered greatly with polarity, but not at all with the induced currents, nor with the action of the diamagnetic metals. The places of maximum and minimum action of a cylinder of metal are very different according as that metal acts by a polar condition or by currents induced in the mass: it is shown by experiments with the diamagnetic metals that their places of maximum and minimum action accord with the effects of induced currents. *Time* has great effect over results produced by currents induced in the mass, and none over those due to polarity. By this test the effects of the diamagnetic metals are found due to induced currents. The phenomena produced by the use of the present apparatus are then shown to be in close and direct relation to the phenomena of revulsion formerly described by the author: the parallel

is closely carried out and extended, and both sets of effects referred to one and the same cause. The author endeavours to repeat an experiment described by Reich, but without success; and he finds that even when iron is used, no arrangement of magnets can produce any test of polarity at all comparable to the use of an astatic needle or to suspension between the poles of a powerful magnet; and thinks that arrangements which are thus less sensible with iron are not likely to be more sensible with diamagnetic metals, even if they are polar. Finally, the author does not consider that the idea of diamagnetic polarity has gained as yet any additional proof beyond the fact, that diamagnetic bodies, such as bismuth and phosphorus, are repelled by one or both magnetic poles: he does not reject the idea of polarity, but his opinion or judgment remains the same as at the time of its announcement in 1845.

ELECTRICITY OF THE AIR.

Mr. Faraday has read to the Royal Institution a paper upon this inquiry. The earth and the surrounding atmosphere have an extraordinary relation to Electricity. The phenomena by which this relation is established may be referred either to *static* or to *dynamic* electricity. *Dynamic* electricity (or electricity in its current condition) occurs but rarely, as in the case of thunder-storms, &c. These are instances of great local disturbance; and there must be an enormous amount of this abnormal action to produce a sensible effect on the galvanometer. It is, however, extremely remarkable that these disturbances occur when the amount of atmospheric electricity is at a minimum. The *static* condition of atmospheric electricity is a subject of much higher philosophical interest. The late M. Peltier devised a process for ascertaining its amount; and this process has for five years been carried on by M. Quetelet, at the Observatory at Brussels.* The principle of the observation is to ascertain by induction at a given and exalted spot the quantity of electricity in the sky. The details of the process are simple: a metallic ball-electrometer is raised, touched, then lowered, and the degree of electricity which it has derived from the atmosphere is examined. From observations made with this instrument M. Quetelet has ascertained that:—1. The amount of electricity at any given moment changes with a vertical displacement of the instrument, but not with a horizontal displacement. 2. That it increases directly with the distance from the earth's surface.—With respect to the annual and diurnal variation of electricity, M. Quetelet has constructed tables recording the mean of his observations for nearly five years, from which it appears—1. That the electricity is greatest in the coldest months. 2. That in the course of the day it is greatest at 8 o'clock A.M. and 9 o'clock P.M. With respect to the conditions of the atmosphere, it appears—1. That the electricity is always greatest when the sky is clear. 2. That the electricity of fog or snow is double that of rain, and equal to the mean maximum of the cold months. With respect to the quality of the electricity in

* See *Year-Book of Facts*, 1850, pp. 176 and 177.

the atmosphere, M. Quetelet observed in the course of five years but twenty-five instances of the atmosphere being in a negative state, and all these occurred either immediately before or immediately after rain or a storm. As to the dependence of electricity on the direction of the wind, it appeared to be greatest when the wind was at from S.E. to E.S.E. and from W.N.W. to N.W.; the interposed minima were at W.S.W. to W. and at N. to N.N.W.

These results having been briefly noticed as deduced from M. Quetelet's tables, Mr. Faraday concluded by reviewing some more comprehensive speculations of M. Peltier on the subject of atmospheric electricity. M. Peltier held peculiar views regarding the nature of negative and positive electricity, and also that the globe is permanently *negative*, and the celestial space surrounding it permanently *positive*. Mr. Faraday made some theoretical and some precautionary objections to these views; but not having time for the development of the matter, ended by wishing it to be understood that he did not accept these views at present, and stated that M. Quetelet had entirely refrained from including them in his investigation and account of the subject.

VELOCITY OF THE ELECTRICAL WAVE.

MR. O. M. MITCHEL, Director of the Cincinnati Observatory, has performed a series of experiments to determine the Velocity of the Electrical Wave in its passage along the telegraphic wires. The paper will be found quoted from the *American Astronomical Journal*, in the *Philosophical Magazine*, No. 243. He states the velocity deduced along the wires, in case the circuit is 607 miles in length, to be 28,524 miles per second.

CONDENSATION BY ELECTRICITY.

MR. C. F. GUITARD, in a letter in the *Mechanics' Magazine*, No. 1407, observes: The genius of inventors has at various times been exercised in endeavouring to produce air and gas motive power. Some of these inventions have been partly successful, but the chief cause of failure has, I believe, been occasioned by the slow or bad conducting power of the aerial fluids themselves. With the object in view of pointing out to future experimentalists a means by which this defect may be remedied, I make the following remarks:—

"Some time since, in experimentalising on the electric state of the atmosphere, I employed for that purpose a large glass cylinder, about 18 inches high, and 9 inches diameter, open at bottom, and having a neck at top. In placing the lower end of this cylinder in water, the more perfectly to exclude the air, and allowing small quantities of tobacco-smoke to enter the neck at top, the smoke, after assuming various actions, according to, probably, the hygrometric state of the atmosphere, would gradually spread itself into a cloud filling the cylinder, and at length, as successive portions came in contact with the sides of the cylinder, condense. Sometimes half an hour would elapse before this effect took place. It now

struck me, that if I brought a wire from an electrifying machine into the neck of the cylinder, the air would immediately become charged with electricity, which would cause each portion of smoke to fly to the sides of the cylinder, and that thus more rapid condensation would take place. The effect produced was perfectly magical; the slightest turn of a small electrifying machine produced immediate condensation. It was astonishing to see how small a quantity of electricity produced a most powerful effect.

"I am not aware that attention has ever been drawn to this subject; and the question will probably arise, has electricity any thing to do with the condensation of steam in the condenser?"

APPLICATION OF CARBON DEPOSITED IN GAS RETORTS AS THE NEGATIVE PLATE IN THE NITRIC ACID VOLTAIC BATTERY.

A PAPER upon this subject, by Christopher Leefe Dresser, Esq., has been read to the Royal Society.

In the Retorts used for the destructive distillation of coal to obtain the carburetted hydrogen gas for the purposes of illumination, after a certain time a deposition of carbonaceous matter takes place; which at length accumulates to such an extent as to fill up a portion of the retort with solid substance, and to line the whole with a coating varying from the thickness of paper to several inches.

After describing several forms in which this substance occurs, and which vary considerably both in density and hardness, the author states that he found one of great hardness, very little, if at all, porous, and of a stony fracture, to be best adapted for the negative conductor of his nitric acid battery. The most convenient form for the negative conductor is the prismatic, $1\frac{1}{8}$ inch square on the side and about 7 inches long, which is immersed 4 inches in the acid, and used with round porous cells, the zinc cylinder being 3 inches in diameter and $4\frac{1}{2}$ inches high.

The carbon is cut into thin plates or prisms by the machine of the marble cutter, at a cost of about $1\frac{1}{4}d.$ each. The prisms may be easily obtained 12, 14, or 18 inches long.

The only precautions necessary in using this form of carbon, are, after using the plates to immerse them for a few moments in boiling water, to take off the adhering acid, and then to dry them before a fire or in a stove.

Having used the same plates and prisms for months, the author detected no deterioration of their conducting power, nor any decomposition or alteration. The connexion was made by soldering a strip of sheet copper to the zinc, and pressing this strongly against the carbon with a clamp.

Comparing these plates with plates of platinum, the author could detect little difference in action, but the carbon appeared rather superior. He states that his battery of 100 plates cost under £4, whilst one of platinum of equal power would have cost £60 or £70. From the cheapness and durability of this substance, he considers that it will make a valuable addition to our voltaic apparatus.

VELOCITY OF ELECTRICAL DISTURBANCE.—ELECTRICAL HOUSES.

At the late Meeting of the American Association for the Advancement of Science, held at New Haven, Professors Olmsted, Loomis, and Silliman, aud Mr. Gould, read interesting papers on Electricity: that by Mr. Gould being an account of a very extensive series of experiments made by the United States Survey on some 1,500 miles of Electrical Telegraph to determine the velocity of the disturbance passing along the signal wires. Prof. Wheatstone had determined the velocity of current electricity as not less than 288,000 miles in a second: Fizeau has more recently inferred from his experiments that the electricity passed through iron wire at the rate of 63,200 miles per second, and through copper wire with a velocity equal to 110,000 miles in the same time. Mr. Gould thinks these values far too high; and he gives as the results of his observations, which appear to have been made with much care, a velocity for the current electricity of not less than 12,000 nor more than 20,000 miles per second as it traverses the telegraphic wire and the earth in completing the circuit connexion.

A communication was made by Prof. Loomis, of novel, and to us curious, phenomena of Electrical Houses. His statement was as follows:—"Within a few years past, several houses in the city of New York have exhibited electrical phenomena in a very remarkable degree. For months in succession they have emitted sparks of considerable intensity, accompanied by a loud snap. A stranger, on entering one of these electrical houses, in attempting to shake hands with the inmates, receives a shock, which is quite noticeable, and somewhat unpleasant. Ladies, in attempting to kiss each other, are saluted by a spark. A spark is perceived whenever the hand is brought near to the knob of a door, the gilded frame of a mirror, the gas-pipes, or any metallic body, especially when this body communicates freely with the earth. In one house which I have had the opportunity to examine, a child in taking hold of the knob of a door received so severe a shock that it ran off in great fright. The lady of the house, in approaching the speaking tube to give orders to the servants, received a very unpleasant shock in the mouth, and was much annoyed by the electricity, until she learned first to touch the tube with her finger. In passing from one parlour to the other, if she chance to step upon the brass plate which serves as a slide for the folding-doors, she receives an unpleasant shock in the foot. When she touched her finger to the chandelier (the room was lighted with gas by a chandelier suspended from the ceiling) there appeared a brilliant spark and a snap. In many houses the phenomena have been so remarkable as to occasion general surprise, and almost alarm. After a careful examination of several cases of this kind, I have come to the conclusion, that the electricity is created by the friction of the shoes of the inmates on the carpets of the house. In order to produce this effect, there must be a combination of several favourable circumstances. The carpet, or at least its upper surface, must be entirely of wool, and of a close texture, in order to furnish

an abundance of electricity. So far as I have had an opportunity to judge, I infer that heavy velvet carpets serve this purpose best. Two thicknesses of in-grain carpeting answer very well. The effect of the increased thickness is obviously to improve the insulation of the carpet. The carpet must be quite dry, and also the floor of the room, so that the fluid may not be conveyed away as soon as it is excited. This will not generally be the case except in winter, and in rooms which are habitually kept quite warm. The most remarkable cases which I have heard of in New York have been of close, well built houses, kept very warm by furnaces; and the electricity was most abundant in very cold weather. In warm weather, only feeble signs of electricity are obtained. The rubber on the shoe must also be dry, like the carpet, and it must be rubbed upon the carpet somewhat vigorously."—Quoted in the *Athenæum*, No. 1196.

EFFECTS OF ATMOSPHERIC ELECTRICITY UPON THE WIRES OF THE MAGNETIC TELEGRAPH.

THE *Revue Scientifique* for December, 1849, contains an interesting article by M. Baumgartner on the subject of the Effects of Atmospheric Electricity upon the Wires of the Magnetic Telegraph. The following are the most interesting of his results:—

1. The needle rarely coincides with the point which is determined by its astatic state and the tension of its suspension thread; almost always it deviates more or less from this point, which proves that it is influenced by an electric current.

2. The variations are of two kinds; there are some which reach 50°, others extend over ½° or 8°. The first are less frequent; they differ so often in direction and intensity that it is impossible to deduce a law for them. On the contrary, the small deviations appear connected by a very simple law.

The observations made at Vienna and at Gratz appear to show that, during the day, the electric currents move from Vienna and from Gratz to Semmering, which is more elevated. This direction is inverse during the night. It appears that this change of direction takes place after the rising and setting of the sun.

3. The regular current is less disturbed by the irregular currents when the air is dry and the sky is serene, than when the weather is rainy.

4. In general, the current is more intense with short than with very long conductors; often, even, the current of the longer chain is opposed to the current of the shorter chain.

Where there is a difference of intensity, this difference is far greater than that which could originate from the resistance of the longer conductor.

When the sky is cloudy and the weather stormy, there are frequently observed in the electric conductor currents which are sufficiently intense to affect the telegraphic indicators, which are, however, far from having extreme sensitiveness.

When they were placing the conducting wires of the Northern Telegraph line from Vienna, the workmen frequently complained of a kind of spasms which they felt in handling the wires. These spasms ceased as soon as they took the precaution not to touch the wires with naked hands. These spasms were most frequent and intense in Styria, the highest region of the line. Thus, near Kranichfeld, a workman received a shock sufficiently violent to overturn him and paralyse his right arm.

The action of the atmospheric electricity on the telegraphs is stronger on the approach of a storm; and not unfrequently the wires themselves, and the poles which support them, are destroyed by electric discharges.

M. Baumgartner cites several examples in support of what has just been said. On the 17th of August 1849, a storm which had burst forth at Ollmutz extended to Frielitz: that is to say, to a distance of ten miles. A workman employed at this latter station, in putting up the wires experienced a shock which overturned him, and he experienced a real burn of the fingers which touched the wire. At this time the sky was perfectly serene at Frielitz.—From the *Journal of the Franklin Institute* for April, 1850.

NEW ELECTRICAL MACHINE.

Mr. W. H. Barlow, F.R.S., in the *Philosophical Magazine*, No. 252, says: "The highly electric properties of gutta percha have been commented upon by Mr. Faraday; but I believe it is not generally known that this material affords the means of producing in a very simple manner an amount of electricity as great as that of the common electrical machine.

"There is a description of gutta percha sold which is thinner than common paper, about three feet wide, and in long lengths. If a sheet of this substance, of about four or five feet superficial area, be laid on a surface or held against the wall of a room, rubbed with the hand or a silk handkerchief, and then carefully removed by the extreme edges and held suspended in the air, it will give off a brush-like spark of several inches in length to the knob of any conducting surface presented to it.

"A similar effect may be produced by causing the sheet of gutta percha to be passed once over one, or between two, rubbing surfaces."

Mr. Barlow then describes the requisite conditions; and the employment of the effects in producing a cheap and simple electrical machine, consisting of a frame carrying two wooden rollers, round which, fitting them very tightly, is made to pass a band of thin sheet gutta percha, about four inches wide. There are two cushions covered with silk, and connected together, so as to press the gutta percha at their upper extremities, and opening towards their lower extremities at an angle of about 20°. When the handle of the machine is turned, causing the gutta percha band to pass at a moderate velocity, electricity is given off at about three or four inches

below the cushions; and if a conductor be applied, the apparatus may be used as a common electrical machine.

The quantity of electricity developed increases with the surface of gutta percha; and from the energy exhibited by so small a band, it is evident that considerable power might be obtained by a more extended application of this material.

Mr. Barlow observed that gutta percha may be excited both positively and negatively.

If a strip about two feet long and two inches wide be laid on a surface and rubbed, the two extremities when suspended in the air repel each other, and the electricity developed is that termed "resinous." But if the strip of gutta percha be folded double and rubbed, the upper side exhibits "resinous," and the lower side "vitreous," electricity; and the two extremities attract each other.

After writing the above, John Westmoreland, one of the workmen in the establishment of Mr. Davis, optician, at Derby (where the apparatus above described was made), constructed a gutta percha electrical machine, similar in principle, but with several improvements.

In this machine, a thicker description of gutta percha band is employed. The upper and lower rollers are of equal diameter; and the rubbers, which are brushes of bristles, four in number, are placed outside the band and opposite to the axis of each roller.

A double conductor connected by a curved brass rod passing over the top of the machine is applied, similar in form to the conductor of the plate-glass machines; and there is an ingenious tightening apparatus, to correct the expansion and contraction of the gutta percha band.

The machine is exceedingly handsome in appearance; and the employment of the thicker gutta percha removes the difficulty experienced in the former apparatus from the band becoming folded.

The band is about four inches wide; and the electricity given off appears to be of higher intensity; and, under favourable states of the weather, nearly as much in quantity as that of an ordinary plate-glass machine.

The improvements above described are all due to John Westmoreland; and this machine (which is beautifully finished, and is intended for the Exhibition of 1851) is the result of his labours after the usual hours of work in Mr. Davis's establishment.

BAIN'S ELECTRIC CLOCK.

This Clock is enclosed in a neat oak case, about 4½ feet in height, and 1 foot 4 inches wide. Its face is of ample dimensions, very plain in appearance, and furnished with second, minute, and hour hands, in all respects similar to those of the usual construction. The pendulum is the same length as that of an ordinary old-fashioned eight-day clock. Here, however, analogy ceases. It is true, there are some wheels and pinions to move the hands, and give the usual indications of the divisions and progress of time. These are few in

number, and do their work in a manner totally different from the wheels in other kinds of clocks. The electric clock has neither weight nor spring, nor power of any other kind, within itself, to keep it in motion; and it, therefore, never requires winding up. The terms employed to denote important parts of common clocks are inapplicable to this. Thus, the escapement of a clock implies some contrivance by which the motive power is permitted to escape; that is, to expend its force in such equal quantity, and at such exactly equal intervals, that the motion of the hands shall be uniform so long as the power is maintained. As the going, or maintaining, power of the electric clock is entirely independent of the machinery, there is no necessity for an escapement.

There are two very fine copper wires fixed in the angles of the clock-case, which communicate with similar wires at the back of the pendulum-bar, and are thence continued to a coil (helix) of the same kind of wire, surrounding an armature of soft iron, and the whole of which is inclosed in a circular brass box. This box constitutes what is usually termed the bob of the pendulum; but whilst it answers that purpose, it performs another and most important duty as an electro-magnet. The box is hollow in the direction of its axis, and the cavity thus formed admits of the insertion of two sets of permanent magnets, whose similar poles are placed near to, but not in contact with, each other. These magnets are kept in their places by being inclosed in brass boxes secured to the sides of the clock-case. The pendulum is so adjusted that it has perfect freedom of motion; in its oscillations, passing and repassing the poles of the magnets just mentioned.

Leaving the clock for a few minutes, we observe two copper wires, the ends of which are in contact with those within the case. Continuing their course along the wall, these wires pass out of doors, descend below the surface of the earth, and, at a short distance from the house, are connected, one with a few bushels of coke, and the other with five or six plates of zinc. These materials are buried in a hole in the earth,—say about 4 feet square, and 5 feet deep. The coke is placed at the bottom, with a layer of earth above it, and the zinc plates are laid thereon; the whole being covered up and forming a galvanic battery. Herein consists the power which imparts motion to the clock. A current of electricity is induced by the coke and zinc, which, although of very low intensity, is unlimited as to the quantity. The pendulum being set in motion, and the current of electricity through the wires established, a beautiful arrangement of simple mechanism immediately comes into operation, by means of which the circuit is broken and renewed at each alternate oscillation. This is effected by a thin bar of steel, the points of which, shaped like lancets, work upon agate bearings. The current of electricity is transmitted through the bar, which is set in motion by the pendulum every time one of the points passes over the conducting wire. The combined agencies of galvano-electricity, electromagnetism, and permanent magnetism, are thus made to produce an

uniform and, so to speak, perpetual motion of the pendulum; and we obtain a time-measurer of such extraordinary accuracy, that it is believed to bear comparison, in this respect, with the best constructed chronometers. Let it be observed, that the electric clock has nothing within itself for putting, or keeping, the hands in motion. The power comes from outside the house, is communicated to the pendulum, and by the pendulum to the wheels. These are small in size and few in number, and have nothing to do but to turn upon their bearings. There is no pulling, or pushing, or straining of any kind, and therefore the least possible amount of wear. The clock here referred to has been going since March 1847. Its rate is uniform, and its fidelity as a time-measurer is one of its most remarkable properties. The battery has never been touched or looked at since it was made. Its power is in no way affected by atmospheric changes, whether of heat or cold, moisture or dryness.

If it be desired to have other clocks in different parts of the house, that above described requires only to be connected with them by a copper wire, and the circuit completed to the battery, when they will all be kept going by the motion of one pendulum, and all record exactly the same time.

Such is the Electric Clock, invented by Mr. Alexander Bain, ot Edinburgh,—a gentleman deservedly known in the scientific world for his successful labours in connection with the Electric Telegraph. —*Mr. Rutter*, in the *Mechanics' Magazine*, No. 1416.

THE ELECTRIC LIGHT.

On January 7, there was an exhibition at Crosby Hall of Mr. Staite's Electric Light, which demonstrated more decisively than has ever yet been done, the capability of its application to domestic and public illuminating purposes. Mr. Staite made use of a regulating magnet on the plan fully described in the *Mechanics' Magazine*, vol. i., p. 48; and most admirably did it perform its functions. In addition to the advantage of being self-acting, this apparatus is so sensitive of the slightest variation in the electric current, and so instantaneous in its controlling action, that no unsteadiness of light is perceptible. Mr. Staite also exhibited a small iridium lamp, in which the illuminating medium was composed, as the name indicates, of iridium; and which appeared to be particularly applicable to domestic and other purposes where a very powerful light is not required, but one that will last long without attention, and be of little cost. Another lamp, in which carbon points were employed for producing the light, was subsequently exhibited; and certainly for steadiness and brilliancy it surpassed every other known artificial light—so powerful, indeed, that the eye could not look upon it without being painfully fatigued. To counteract this to some extent, it was inclosed in an enamelled glass globe of about 24 inches diameter, which appeared as an enormous globe of pure and brilliant white light. There can be little doubt that ere long we shall see gas and oil-lighting, with all their attendant evils of blacks, heat,

&c., replaced, at least in all large public buildings and thoroughfares, by the electric light.

The above has been communicated to the *Mechanics' Magazine*, No. 1379, by an accredited Correspondent; to which the Editor adds:—"It does appear from it, that all the difficulties of the case have at length been really surmounted, and an actual electric lamp produced, which gives a steady, enduring, and most brilliant light, without any perceptible flickering or intermission."

An experiment has been made in the chemical lecture-room of the Polytechnic Institution, in the presence of a select party of scientific persons, to test the power of the voltaic light for which Mr. Allman has obtained patents, and to prove that the light could be kept up continuously. The result, as far as the experiment went, was satisfactory; the light continuing without intermission to diffuse the most brilliant rays for several hours. This is considered a great advance in electric lighting, as in former experiments the spark has been intermittent and flickering. It was stated that the expense of lights of this class would be less than the expense of gas, even at the reduced rate; and that in the event of the invention being brought into general use its expense would be greatly diminished. The brilliancy was of extreme intensity. We have reason to believe that Mr. Allman's light was more steady than that of Messrs. Staite and Petrie; but the cost is a question which has never yet been fairly met. The best way of meeting the assertion that the light can be produced at a less cost than gas, is to fix the patentees to lighting the Parks during next year for a sum under that at which it would be most readily done by any of the gas companies.—*Athenæum*, No. 1205.

IMPROVEMENTS IN ELECTRIC TELEGRAPHS.

Professor Morse has patented certain improvements, which, he states, consist, 1st. In the application of the decomposing effects of electricity, produced from any known generator of electricity, to the marking of the signs for numerals, or letters, or words, or sentences, invented and arranged by me, and secured by patent bearing date June 20th, 1840, re-issued January 15th, 1846, and again re-issued June 13th, 1848, or their equivalents, through a single circuit of electrical conductors. 2d. In the mode of applying this decomposition, and the machinery for that purpose. 3d. In the application of the bleaching qualities of electricity to the printing of any desired characters.

The patentee claims—"1st. The use of a single circuit of conductors for the marking of my telegraphic signs, already patented, for numerals, letters, words, or sentences, by means of the decomposing, colouring, or bleaching effects of electricity, acting upon any known salts that leave a mark as the result of the said decomposition, upon paper, cloth, metals, or other convenient and known markable material.

"2d. The combination of machinery as described, by which any

two metallic points, or other known conducting substance, broken parts of an electric or galvanic circuit, having the chemically prepared material in contact with and between them, may be used for the purpose of marking my telegraphic characters, already patented in letters patent, dated 20th of June, 1840; in the first re-issue, 15th of January, 1846; and second re-issue, 13th of June, 1848."

ELECTRO-CHEMICAL TELEGRAPHS.

THIS invention, patented by Messrs. Westbrook and Rogers, of the United States, is stated to consist in recording telegraphic signs on a metallic surface, connected with the earth by a wire conductor at one end, and to a galvanic battery and the earth at the other end of the circuit, by the use of acidulated water or other fluid interposed between the point of the usual wire conductor leading from the operating apparatus connected with a galvanic battery of the ordinary construction, and the metallic surface, by which the use of paper is dispensed with; time being also saved in not having to moisten the chemically prepared paper when it becomes too dry for use, and in having the telegraphic signs more clear and distinct on the metallic surface than on the paper; and in avoiding the inconvenience arising from the fumes from the chemicals employed in preparing the paper, with evils arising from the corrosion of instruments, and in annoyance to the operators in preparing and using chemical paper and other inconveniences.

The patentees claim recording telegraphic signs on the surface of a revolving metallic cylinder plate, or other equivalent surface, by means of an acidulated liquid or saline solution, or water held between the point of the wire conductor and the metallic recording surface, by means of a non-conducting porous substance contained in a glass, or other non-conducting reservoir, in which the recording fluid is contained, to which the electric current from a battery is applied by means of any of the known forms of manipulators and anvils used for making and breaking the circuit; the recording fluid being applied to the metallic recording surface substantially in the manner herein fully set forth, by which the use of every description of paper is dispensed with, thereby saving a great expense in telegraphing.

BAIN'S ELECTRIC TELEGRAPH.

AN experiment has been made in Paris, at the Elysée, by order of the President of the Republic, with the Electric Telegraph of Mr. Bain. The telegraph was fixed up in the grand saloon of the Palace. Mr. Bain, the inventor, was accompanied by Mr. Macdougall, by Mr. Wilkinshaw, and by Dr. Lardner. The President was attended by the Minister of the Interior, his *chef du cabinet*, &c. M. Leverrier, of the Institute, who has taken great interest in the invention of Mr. Bain, and who had been present when the telegraph conveyed a long dispatch to Lille and back, a distance of 325 English miles, in less than one minute, explained the process to the President of the Republic.

As another instance of the extraordinary powers of this telegraph, we may mention that, in the presence of the President of the Republic, a dispatch, containing 1,327 letters, was conveyed in the space of 55 seconds, being at the rate of nearly 1,500 letters per minute.—*Galignani's Messenger.*

THE SUBMARINE ELECTRIC TELEGRAPH BETWEEN ENGLAND AND FRANCE.

THE long-promised experimental operations for establishing a Telegraphic Communication, by means of wires sunk in the Channel, between Dover and Calais, were commenced at Dover on Tuesday, the 27th August. At one o'clock, the steamer, *Goliath*, was in readiness, steam up, at Dover Harbour, to start across the Channel, with all the necessary apparatus and machinery on board, and a crew of about thirty men, consisting of pilots and sailors, under the superintendence of Messrs. Jacob Brett, W. Reid, C. J. Wollaston, C.E., F. Edwards, and others. Between the paddle-wheels, in the centre of the vessel, was a gigantic drum, or wheel, nearly 15 feet long and 7 feet in diameter, weighing 7 tons, and fixed on a strong framework. Upon it was coiled up in close convolutions about thirty miles of telegraphic wire, in a covering of gutta percha half an inch in diameter. The point proposed to be reached, Cape Grinez, the nearest landmark to the English coast, and between Calais and Boulogne, is a distance of 21 miles: so that a surplus supply of nine miles of wire was held in reserve for the purpose of slackening. The intention was to steam out at five miles an hour, to pay out progressively the whole extent of telegraphic tackle, and to imbed the wire in the bottom of the sea by means of leaden clamps, of which there were some hundreds on board, of 20 lbs. and 25 lbs. in weight. The vessel was provisioned for the day, and Captain Bullock, of her Majesty's steam-ship *Widgeon*, caused the tract of the navigation to be marked in as direct a route as possible, by placing a series of pilot buoys with flags on the route; besides being prepared to accompany the experimental cruise with his own vessel as a tender. The connecting wires were placed in readiness at the Government Pier in Dover harbour, and likewise at the Cape, where they ran up the face of the acclivity, which is 124 feet above sea-mark. The necessary batteries and manipulators were all on board, but as a gale and rolling sea unexpectedly sprung up over a previously comparatively calm sea, it was deemed unadvisable by the experimenter to venture out, and the operation was adjourned. Some interesting experiments, however, were made on a small scale, to show the practicability of the plan. A mile of wire was paid out off deck from the pier, to Shakspeare's Cliff, and the sinking process was proved to be practicable of performance. A communication to the following effect was also sent through 24 miles of wire:—"Printed by Electric Telegraph, on board the *Goliath* steam-boat."

On Wednesday morning the experiment was renewed, with complete success. The *Goliath* started from Dover at half-past 10

o'clock, provisioned for the day, with a crew of about thirty men, and proceeded at a rate of about four miles per hour, preceded by the *Widgeon*, Captain Bullock, R.N., as pilot, who had caused the track in a direct line to Cape Grinez to be marked by buoys and flags on staves. The wire continuously streamed out; and at every sixteenth of a mile a leaden clamp or weight, before mentioned, was securely riveted on, to secure it at the bottom ot the sea. Interesting salutations were kept up hourly, during the progress of submerging the wire, between the gentlemen on board and Mr. John Brett.

The sea at Dover is about 30 feet deep, increasing as the track proceeds to about 30 fathoms, or 180 feet, which is the greatest depth, except in mid-channel, where there is a point called the Ridge, and another the Varn, both shallows, and dreaded by navigators—one 17 miles in length, and the other 12. Between these there is a deep submarine valley, surrounded by shifting sands, in which ships lose their anchors, and fishermen their nets.

On nearing Cape Grinez, the soundings become very rugged, and the coast dangerous; but by steady and cautious manipulation, the *Goliath* delivered her cargo of wire to be safely connected with the end of the tubing which had been laid at Cape Grinez, and run up the cliff to a temporary station at its summit. This was completed the same evening, and every accommodation was afforded by the persons at the lighthouse, in the use of lanterns and lamps, so that at nine o'clock (the 28th of August) the following message was printed, in legible Roman letters, upon a long strip of paper, by telegraph, in the station on the French coast:

THE MESSAGE.

"Cape Grinez, Coast of France: half-past eight, P.M.
"[By Submarine Telegraph.]

"The *Goliath* has just arrived in safety; and the complete connexion of the underwater wire with that left at Dover this morning is being run up the face of the cliff. Complimentary interchanges are passing between France and England under the straits, and through it for the first time. The French mail, *ut mos est*, may not arrive at Dover at the time of going to press; but in a short time, on the necessary arrangements being complete, Paris news and closing prices at the Bourse will be communicated by a mail that sets time and detention at defiance."

This triumph was, however, but of short duration; for in a letter dated Dover, September 4, it was stated the wire so successfully submerged in the preceding week had been cut asunder among the rocks at Cape Grinez, where the physical configuration of the French coast had been found unfavourable for it as a place of holdfast or fixture. All communication between coast and coast consequently became suspended. The precise point where the breakage took place is 200 yards out at sea, and just where the twenty miles of electric line that had been paid out from Dover joined on to the leaden tube, designed to protect it from the surge beating against

the beach, and which served the purpose of conveying it up the front of the cliff to the telegraph station on the top. This leaden conductor, it would appear, was too soft to resist the oscillation of the waves: hence it became detached from the coil of gutta percha wire that was thought to have been safely encased in it. The occurrence was, of course, quickly detected by the sudden cessation of the series of communications that had been sustained since the first sinking of the electric cable between Dover and Cape Grinez; though at first it was a perplexing point to discover at what precise spot the wire was broken or at fault. This, however, was done by hauling up the line at intervals, which disclosed the gratifying fact that since its first sinking it had remained *in situ* at the bottom of the sea, in consequence of the leaden weights or clamps that were strung to it at every 16th of a mile. The operation was accomplished by Messrs. Brett, Reid, Wollaston, and Edwards, who attended to the management of the telegraph without intermission, and who, with their staff, removed the wire to a point nearer Calais, where, from soundings, it has been ascertained that there are no rocks, and the contour of the coast is favourable. The experiment, as far as it went, proved the possibility of the gutta percha wire resisting the action of the salt water; the fact of its being a perfect water-proof insulator; and that the weights on the wire were sufficient to prevent its being drifted away by the currents, and to sink it in the sands.

Meanwhile, arrangements are in progress for the relaying of the telegraph more securely; and, in our next volume, we hope to have to record the complete success of the project. All the ingenuity of its promoters is at work to be prepared to meet the emergency. Of currents it may be stated that there is no fear; since it has been ascertained that at certain fixed fathoms, even in the rapids of the Mississippi or at the Menai, there are none below three or four fathoms, and that at five fathoms there is calm water. In order to meet all existing or conjectured difficulty, the character of the undertaking, so far as its magnitude and solidity are concerned, will now be altered. The electric wire, thin as a lady's staylace in itself, will now be incased either in a 5-in. or a 10-in. cable of the diameter of those that placed the Britannia tubes in position, and these will be submerged by the aid of enormous weights. The wire will be imbedded in this gigantic coil or cable, composed of what is called whipped plait with wire rope, all of it chemically prepared, so as to protect it from rot, and kyanised; the whole to be chained down, as it were, as the rails are on a railway, by the gravitation of the huge weights in the bottom of the sea.

THE COPYING ELECTRIC TELEGRAPH.

THIS ingenious application of the Electric Telegraph is the invention of Mr. F. C. Bakewell, of Hampstead.

The arrangement, by means of which the copying process is performed, is extremely simple. The messages to be transmitted are

written on tinfoil, with sealing-wax varnish, and are then applied to a cylinder on the transmitting instrument. A metal stile connected with the voltaic battery presses lightly on the writing; and, as the cylinder revolves by the influence of a weight, the metal point is carried by a fine screw, on which it traverses, from the top to the bottom of the lines of writing. By this arrangement, the stile passes several times over each, but in different parts, of the letters. The receiving instrument resembles the transmitting one; but on the cylinder of that instrument, paper moistened with a solution of prussiate of potass and diluted muriatic acid is applied, and the metal stile consists of a piece of fine steel wire. The electric current from the positive pole of the voltaic battery is conducted by a communicating wire to the steel point, and passes through the paper to complete the voltaic circuit. The action of the electricity, when the current is passing, decomposes the muriatic acid, and, the steel combining with the chlorine of the acid, a deposition of iron takes place on the paper, which is instantly converted into prussian blue by the prussiate of potass. By this arrangement, therefore, the steel point of the receiving cylinder draws a succession of blue lines spirally over the paper when the electricity is passing through it; but when the electric current is interrupted by the varnish writing, over which the point of the transmitting cylinder is continually passing, the electric current is momentarily interrupted, and the marking ceases. The small intervals caused by the cessation of marking, where the varnish interposes, produces an exact copy of the written message on the paper, the letters appearing nearly white, on a ground composed of blue lines drawn very closely together.

It is essential to the success of the process that the two separate instruments should rotate exactly together, otherwise the receiving paper would present a confusion of marks, instead of legible writing, for the different parts of each letter would be marked irregularly. To produce the synchronous movement, Mr. Bakewell has contrived an electro-magnet regulator, by which means the effect may be produced at whatever distance the instruments may be apart. The elec ro-magnet regulator my be applied in several ways. The plan that would be adopted in practice is to make and break contact with separate batteries that work the electro-magnets, by means of pendulums actuated by clock-work. Each instrument would have a separate pendulum and electro-magnet; aud each time that the electro-magnet is brought into action by the pendulums striking against fine springs, the keepers of the electro-magnets act as detents or projections on one of the wheels, and thus regulate the instruments by retarding them; so that at every beat of the pendulum the instruments are made to correspond. Another mode of applying the electro-magnet regulator is to make and break contact by means of a small wheel on the transmitting instrument, and to employ one electro-magnet, which retards the receiving instrument by the action of the transmitting one; the former being weighted to rotate rather faster than the latter, when not checked by the retarding

magnet. The latter plan of regulating the instruments is best adapted for the temporary adjustment of a lecture-room. In order to adjust the instruments when at a distance, so as to know exactly how much weight to apply to each, Mr. Bakewell employs what he terms a guide line, which consists merely of a narrow strip of paper pasted across the cylinder of the transmitting instrument. By this means, the distant operator at the receiving instrument can ascertain with the greatest exactness how much it is gaining or losing; and, by adding or taking away weights, he may bring the movements of the two instruments to correspond as closely as clock mechanism, without the use of the electro-magnetic regulator, can do, and with as much facility as if both instruments were together.

The number of times absolutely requisite to pass over each line of writing to make the copy legible, is six; but when the screw is fine, and the writing large, the point passes over a greater number of times to bring out the forms of the whole letters. The rapidity with which the copying may be done depends in a great measure on the smallness of the writing. Specimens of round-hand which we saw were taken at the rate of 140 letters per minute, with a single marking point; but Mr. Bakewell states that he has copied 300 letters within the minute, and he expects to be able to do at least 500 with instruments properly adapted for quick writing.—*Illustrated London News*, No 456.*

NEW VOLTAIC BATTERY.

PROF. H. REINSCH, in the *Jahrbuch* of Practical Pharmacy, describes a New Voltaic Battery of considerable power without the use of any exciting metal. A common porous cell is filled with powdered coke, into which is fixed a rod of coke for conducting the current. This porous cell is placed in a jar or glass, which is then filled with coarse bruised coke, to which is also connected a rod of the same material. The coke in the inner cell is moistened with nitric acid,—that in the external one with a saturated solution of common salt: conducting wires being attached to the coke cylinders, a tolerably strong current is indicated. Dr. Reinsch has rendered a small electro-magnet sufficiently magnetic by this current to sustain half a pound; but a large electro-magnet was not affected by it. The spark and shock have been very decidedly obtained from a single compound cell; and, from the indications afforded, we may hope to obtain much greater power at a small cost of material.—*Athenæum*, No. 1185.

TERRESTRIAL MAGNETISM.

ON March 15, the Astronomer-Royal read to the Royal Institution (H.R.H. Prince Albert, Vice-Patron, in the chair), an important paper "On the present State and Prospects of the Science of Terrestrial Magnetism." The subject of the lecture is not the

* See also a description of Mr. Bakewell's patent of this invention in the *Year-book of Facts*, 1849, p. 161.

exhibition of new and successful experiments, but the indication of trains of scientific reseach, in which, at present, all is doubtful and difficult. We have not room for the means employed; but pass on to the general character of the results, pointed out by the lecturer.

As regards the mean or average determinations (omitting the slow or secular changes, and deferring for a moment the rapid changes), nearly all collectors of results for declination, from the time of Halley, had conceived the existence of four magnetic poles:—two (the Hudson's Bay pole and the Australian pole) having been nearly reached by voyagers; and two (the Siberian pole and the Cape Horn pole) being only inferred from the convergence of the directions of the needle. It had, however, been shown by M. Gauss that a theoretical investigation which would give as one of its consequences this convergence of direction, would also negative the existence of the supposed poles; and on the whole the lecturer expressed himself as now doubtful of the existence of these poles. He expressed his regret that an idea long ago explained by Prof. Christie had not been followed out,—namely, of the preparation of charts showing the lines perpendicular to the direction of the needle. A chart of the entire magnetic force was exhibited; and the general fact of no dip near the equator, and increasing dips of the austral end of the needle in the north, and the boreal end in the south, was mentioned.

"The next class of facts mentioned was the diurnal variation:—that in northern latitudes the austral end of the horizontal needle points farthest to the east at about eight in the morning, and farthest to the west at about two in the afternoon. In southern latitudes the change is in the opposite direction; and in low latitudes, as at St. Helena (Col. Sabine), and on the Red Sea (M. D'Abbadie), the change has the north-latitude character during the north-latitude summer, and the opposite character during the opposite season. The horizontal and vertical forces generally increase from morning to evening.

The third class of facts was the momentary changes' first brought to light by the observations of the German *Magnetische Vereins* (already mentioned). These had appeared to the lecturer so important that, principally for the better recording of them, he had brought before the British Association the importance of recommending to the Government to hold out the prospect of pecuniary reward to the inventors of effective self-registering apparatus. The Government had liberally responded to the application, and the consequence was, that most beautiful and effective photographic self-registering apparatus, constructed respectively by Mr. Brooke and Mr. Ronalds, had been combined with the free magnet, the bifilar magnet, and the vertical-force magnet, and had now been brought into daily use at the Royal Observatory of Greenwich, and Toronto; and that their use appeared likely to extend. The general fact exhibited by the five-minute observations and by the photograph record is this:—The changes of direction of the horizontal needle and of the horizontal and vertical forces are incessant, and, as examined at any one place, appear most capricious. But if compared at several neighbouring places,—for instance, not exceeding five hundred miles apart, they are found to be exactly similar: if the distance be increased, the similarity diminishes; and if places be selected spread over the globe, it is usually found that a large disturbance at one place is accompanied by large disturbances at the other places; in which, however, it is difficult to trace the relation of the contemporaneous movements at the different places. Diagrams exhibiting these phenomena were placed before the meeting. The lecturer pointed out one instance as strikingly showing how these phenomena appeared to indicate a distinct localization of their cause. Thus there were two disturbances of horizontal force at five stations (Catharinenburg, St. Petersburg, Greenwich, Göttingen, Milan), occurring at an interval of about a quarter of an hour; one of them showed increase of force at all the stations, the other showed decrease at the two first-named stations and increase at the others: it appeared evident here, that the cause of the first was exterior to Europe, and the cause of the second was within Europe.

The division of the subject to which the lecturer then came was

the cause of these phenomena. He illustrated by a model Hansteen's conception of two large magnets within the earth, stating that he understood it to be put forward only as an imaginary construction, generally (but not very accurately) representing the facts, but not to be taken for a representation of a real state of things. He then adverted to Gauss' beautiful and general investigation of the effects of a magnetic earth, supposing that every part of it was magnetic in every conceivable variety of manner and degree; and stated that, by proper adaptation of certain constants in this general theory (a theory which it is totally impossible to express in ordinary language), all the recorded observations of the mean positions of the magnets might be well represented. But M. Gauss had stated the following as one consequence of the theory:—Supposing that every part of the earth has equal magnetism in the most favourable direction for producing the known effects with the smallest expense of power, then the quantity of magnetism in one cubic metre of the earth is equal to the magnetism of eight of the best steel magnets weighing 1 lb. each. This, in the lecturer's opinion, made the whole theory difficult to be received.

Connected with the theory of general magnetism of the earth, is Canton's explanation of the diurnal inequality. He supposed that if there were, near the equator, two magnets in N. and S. positions, one more east and the other more west than England, the rising sun would heat the eastern magnet, and thus (by a law which applies to steel magnets) would diminish its magnetic power; and the effect of the western magnet would then turn the English needle to a position verging more to the N.W. and S.E. until the two magnets were equally heated.

The lecturer then exhibited experimentally Œrsted's discovery, that a simple helix of wire, through which a galvanic current passes, possesses all the properties of a bar-magnet, its opposite ends exerting opposite effects upon one pole of a magnet, and these effects being reversed upon testing it on the other pole of the magnet. From this it followed naturally, that a model of a sphere surrounded by a spherical helix carrying a galvanic current would nearly represent the condition of magnetism upon the earth,—and Barlow's experiment to that effect was exhibited; when it was shown that its action on a free dipping-needle is generally similar to the earth's action. He next adverted to Lubeck's discovery—that the application of heat to the point of junction of two different metals (as bismuth and antimony, or bismuth and copper) creates a galvanic action, as is shown by connecting wires with the two ends of the united metals and forming a circuit; and observed that here we seemed to have in nature a cause whieh might explain the origin of Terrestrial Magnetism. Attention was then called to the general similarity of Sabine's lines of equal magnetic intensity with Humboldt's lines of equal temperature; the lecturer remarking, that a much greater similarity would have been seen if he had been able to display a chart of lines perpendicular to the direction of horizontal magnetism, as proposed by Professor Christie. Allusion was then made to the very remarkable experiment by Professor Christie, in which a disc of bismuth being surrounded by a ring of copper, and heat being applied to the edge of the copper, an extraordinary amount of magnetism was developed; two poles, austral and boreal, being produced at certain points on one surface, and poles of opposite character (separated from these by the thickness of the bismuth only) on the opposite surface. Professor Christie had endeavoured to extend this experiment to the case of a spherical copper shell

filled with bismuth, and heated generally at the equator, but more particularly at one point; and the results appeared, as far as they went, to correspond well with the state of terrestrial magnetism; but the difficulty of insuring a good union between the copper and the bismuth (a difficulty which perhaps might now be overcome by electrotyping) had made the results somewhat uncertain.

The lecturer then remarked that, for the advancement of the truly scientific part of this inquiry, it does not appear that we have need of any new expeditions or of any further accumulation of observations made on the present plan. We have already vast collections of observations which will be useful till they are published, and which cannot be properly considered in a few years. Still, their discussion is recommended as likely to suggest new instruments of observation, great importance being due to the small disturbances. Photographic self-registration should be substituted, in every fixed observatory, for eye-observations; the magnets should be improved, so as to be sensible to more rapid disturbances; and the photographic paper should be so improved that a momentary beam of light may make an impression upon it. But any suggestions as to the course to be pursued in tracing the causes of magnetism must be guided by the opinion of the person who undertook the inquiry. The lecturer's own belief is, that thermo-electricity is the fundamental cause: and in this belief he expressed his opinion that the importance of experimental investigation of the laws of thermo-electric magnetism, where broad surfaces of different metals are contact, is paramount to every other. An experimenter might commence with Christie's valuable experiments, and extend them as the results should seem to guide him. Too great importance cannot be attached to experiments as distinguished from observations. It would probably be found that the successful course would be to confine the examination to a single momentary disturbance, which could be traced well through all the magnetic observatories in the world—(the instance to which the attention ot the audience had been previously directed, showed the absolute necessity of limiting the disturbance to the shortest time possible)—and with such lights as experiment could give to determine by some mathematical process the locality of the disturbing cause. But no rule could be given for the process to be used. (See the entire paper in the *Athenæum*, No. 1169.)

NEW RESEARCHES ON THE CONDUCTIBILITY OF THE EARTH. BY PROFESSOR MATTEUCCI.

THE following communication has been read to the Chemical Section of the British Association:—"Although the good conducting power of the earth is at present generally admitted, and is advantageously applied to the construction of electrical telegraphs, it must be confessed that nothing has been hitherto known of the laws and theory of this singular phenomenon. In England, Germany, and Russia, it has been found advisable, for several years past, to form the telegraphic circuit partly with the earth and partly with me-

tallic wire only. I was, I believe, the first to show, by exact experiments, made in 1844 at Pisa, and by others performed according to my propositions at the Scientific Congress of Milan, that *the resistance of the earth* to the passage of the electrical current, which is sensible in short distances, ceases to increase and remains constant when the distance between the electrodes plunged in the earth has attained a certain length. Having latterly renewed my studies on this subject, I have confirmed and extended in a complete and general manner the conclusions drawn from my former researches: I have also demonstrated the principal result, given above, by different experimental processes. I have compared the resistance of a mixed telegraphic circuit with that of an entirely metallic circuit, containing a length of wire twice as great as that employed in a mixed circuit. I have also formed metallic circuits of very fine brass wires, having the same resistance as the metallic portion of a very long mixed telegraphic circuit; and finally, by making use of long metal wires covered with gutta percha, I have been able to compare the resistance of an entirely metallic circuit with that of a mixed circuit, in which the metallic portion remained constantly the same, and to which were added different lengths of earth. The following are the principal conclusions drawn from experiments which have occupied me for about a year.

"The resistance of a layer of earth to the passage of the electrical current varies according to the quantity of water contained in the earth of which it is composed,—according to the specific gravity of that earth,—according to its depth beneath the surface,—according to the nature of the electrodes and extent of their surface. This resistance does not increase with the increased length of the layer of earth; on the contrary, beyond a certain limit of length, which varies according to the different circumstances just indicated, but which in all cases is of little extent, the resistance of a layer of earth *remains constant* whatever be its length. It is unnecessary to say that I could not prove this fact by experiment on circuits exceeding eighty miles in length, such being the average of the telegraphic circuits in Tuscany. In making the experiment near the surface of the soil, it is difficult to plunge the electrodes in earth of exactly the same conducting power: different portions of the surface of soil possessing either better or worse conductibility than that on which I began to operate, it follows that, in increasing the distance between the electrodes, we may find either an increase or diminution in the resistance of the earth. Likewise, in operating on a long mixed telegraphic circuit, which is not perfectly isolated, owing to the effect of the different derived circuits formed between the posts and the earth, the electric current is stronger near the pile than at a distance, and stronger than in a circuit which is formed only of metal wire equal in length to that which enters into the mixed circuit. This explains the results which I had obtained from my former uncompleted experiments. The resistance of a layer of earth appears to diminish as its length increases only in cases where we

meet with other layers of better conducting power. In every layer of earth of a certain *constant* conducting power, the resistance, which at first increases very feebly with the increased length of the layer, becomes very soon constant, and continues the same for all the subsequent lengths, however great, on which experiments have been made. Now it is evident, that as the increase of resistance in a long metallic circuit is scarcely perceptible when we add to the circuit, by means of two large electrodes, a thin stratum of water; so we ought to find in the long mixed telegraphic circuits that the resistance of the earth is null or nearly so, since it is equal to that of a thin stratum of water of a very large section.

"The law of the conducting power of the earth being established, it remains to give the theory of this phenomenon. The opinion of the scientific world is divided on this point. Some explain the good conducting power of the earth by the almost infinite section of the earth compared with the distance of the electrodes; others, again, suppose that the electricities at the two extremities of the pile are dissipated in the earth in the same manner as the electricity of the conductor of an electrical machine. This second explanation will not bear the slightest examination, nor can it be made to tally with the results of the most elementary experiments relative to the conducting power of the earth. In fact, we cannot on this supposition explain why the resistance of the earth increases at first with the length of the layer; why it varies with the depth and the degree of moisture of that layer; why it changes if the mass of earth interposed between the two electrodes happens to decrease or to be wanting, as I have proved by experiments made in mountainous districts; why the interposition of a portion of earth of a different conducting power produces a variation in the resistance of the entire mass; and why this resistance becomes infinitely greater when we keep this layer in a wooden trough separate from the earth, but in communication with it by means of large metallic plates.

"Finally, according to this explanation, the resistance of the metallic part of a mixed circuit ought to disappear,—a thing which never happens. I think that I may be able to give a satisfactory explanation of the good conducting power of the earth, founding my assertions on very simple experiments, and on theoretical views already known. As long ago as 1837, I proved in a memoir published in the *Annales de Physique et de Chimie*, that in operating on a certain liquid mass, very considerable compared with the distance of the electrodes plunged in it, *the length of the intermediate liquid stratum has no sensible influence on the intensity of the current.* I have recently verified this result on a very large scale. I had a wooden case made seven metres in the side. I keep this case isolated from the earth, and filled with water. Operating on this mass of water, we find that the resistance of a certain stratum of water, variable within certain limits, is independent of its length. In like manner, in studying the conducting power of spherical masses of water varying in diameter from $2^{c.m}$ to 30 or $40^{c.m}$, I have found that the resistance

of these spherical masses of water was the same, and independent of their diameter. I have already said that this result may be deduced from the theory, and this is done as follows :—From the same differential equations, given first of all by Fourier in his celebrated theory of heat, and which Ohm has applied to electricity, suppressing in the latter case the terms which expressed the dispersion of heat in the air, are deduced, in the case of the sphere, the results which I have obtained by experiments on the propagation of electricity in the earth. Although we are as yet ignorant of the physical value of that variable U which figures in the fundamental equation of Ohm at three partial differentials, which is the same as that of Fourier in the propagation of heat ; and although that equation would really be more applicable to the case of the metallic wire which communicates at one extremity with the conductor of an electrical machine in action, and at the other extremity with the earth, than to the case of the electrical current defined by its electro-chemical and electro-magnetical action ;—it is no less true that a certain number of the phenomena of the electrical circuit are explained by representing the propagation of the electrical current by the same equation given by Fourier in his theory of heat. Among these phenomena may he placed the fundamental law of the propagation of electricity in metallic wires according to their section and length, and the other more general cases of the propagation of the electrical current, and of derivation, in large metallic plates, or in spherical masses and in the earth, such as they have been found by MM. Kirchhoff and Smaaeen in Germany, and in Italy by my friends Ridolfi and Felici."

The reading of this communication from Prof. Matteucci led to a conversation on the various methods employed by the Electric Telegraph Company and others; and on the question of the investigations of Messrs. Bain and Wheatstone in England, and several experimentalists on the Continent, prior to these investigations of M. Matteucci as to the power of the earth to conduct electricity. Mr. R. Hunt explained that, in speaking of the conductibility of the earth, it should be distinctly understood that the water contained in the superficial stratum is the conducting medium ;—since he has proved that non-metalliferous rocks and dry earth will not conduct an electric current.—*Athenæum*, No. 1189.

Chemical Science.

ON THE INTERPRETATION OF MARIOTTE'S LAW. BY LIEUT. E. B. HUNT, U.S. CORPS OF ENGINEERS.

It is readily demonstrated that in any entirely *homogeneous* medium, the component parts of which act on each other by forces varying as any fraction of the distance, Mariotte's Law must prevail. Both elastic tension and cohesive force will necessarily vary as the density, in a medium assumed as homogeneous, quite irrespective of the law of force; the variation being expressed in terms of distance between the component parts of the medium. Whether the force be attractive or repulsive, varying inversely with the first or hundredth power of the distance, the result is the same; that *entire homogeneousness makes Mariotte's law necessary.—Philosophical Magazine,* No. 247.

IDENTITY OF LIGHT AND HEAT.

M. Moigno has called attention to an important physical fact observed by him some time since, and recently confirmed by the researches of Matteucci, which appears to indicate some striking difference between the calorific and luminous agencies, and to be opposed to the commonly-received views of the Identity of Light and Heat. It has been shown that, in all cases, the negative pole of a voltaic battery or pile becomes luminous previously to the completion of the electric arc, and that it is relatively much colder than the positive pole. It is hence inferred that light is developed in virtue of some peculiar function of the negative pole of the battery, independent of the process of combustion which constitutes the phenomenon of the ordinary electric light; and that heat is constantly developed with superior intensity at the positive end of any voltaic arrangement. There are so many important considerations involved in the question of these dissimilar influences, that the results obtained by M. Moigno will, without doubt, undergo an extensive and careful examination.—*Athenæum*, No. 1185.

CHEMICAL FACTS CONNECTED WITH THE TESSELLATED PAVEMENTS DISCOVERED AT CIRENCESTER (THE ROMAN CORINIUM). BY PROFESSOR BUCKMAN.

In this paper it was shown that the materials of which the pavements are composed are of two kinds:—The first derived from rocks of the district, and termed natural; the second composed of clay, fictilia, and glass—artificial tessellæ. The natural tessellæ, many of which are so altered by chemical manipulation as to cause them to be referred to foreign rocks, consist of bits of stone from the chalk, oolite, lias, and red sandstone formations, and were clearly referred to their origin; and the processes by which they were prepared for pavements were pointed out. Thus a gray colour was produced

from a cream-coloured oolite, the change of colour being caused by a process of roasting. This is dependent upon the fact that the oolite bed of which they are made contains iron and organic matter, the latter of which prevented the iron peroxidizing, and thus the grey was due to a protoxide of that metal. The artificial tesselæ from pottery consist of shades of red and black; the reds all being due to a peroxidation of the iron in the clays from which they were made,—whilst the blacks were the result of baking in "smother furnaces," as long since pointed out by Mr. Artis; so that the carbonaceous matter of the fuel with which the baking was effected was prevented from escaping, and, as he would lead us to infer, the black smoke penetrated the clay and thus blackened it. The author, however, showed that this smoke acted chemically, by preventing the oxidation of the iron; and thus the change from the dark colour of the clay to red, which usually occurs in burning pottery and bricks, was prevented. Reference was then made to a medallion in the pavement representing Flora, in the first drawing of which the head-dress and flowers held in the hand were coloured verdigris green, the hue these objects presented on being exhumed; but as this was unsatisfactory in chromatic arrangement, the author suspected some chemical change had occurred since the pavement was put down; and on scraping away the green from the surfaces of the tessellæ in question, a beautiful ruby glass presented itself. New drawings were then made with ruby instead of green colour: the result of which was, that what was before inharmonious in colour and grouping, at once resumed harmony in these respects, and became perfectly intelligible. An analysis of the glass made by Professor Vöclcker showed the cause of change from ruby to green to have been due to the fact that the antique ruby glass had derived its colour from suboxide of copper, and that the tessellæ had become covered with carbonate of copper from a decomposition of their surfaces.—*Proc. Brit. Assoc.* 1850; *Jameson's Journal*, No. 98.

This fact is curious in its bearing upon the pavement as a work of art; as so harmoniously are the colours arranged in all the figures that it may almost be taken for granted that, as in this instance, when there is an exception in this particular, it is due to some subsequent change having taken place in one or other of the colours. In the case befo:e us our first tracing was coloured with the verdigris-green: it was unsatisfactory; but on making a new tracing, and colouring it according to our amended observations, it at once became harmonious in colour, and assumed an intelligible form, though all our colouring will not enable us to convey the idea of ruby-gemmed flowers like the substance used, the transparency of glass contributing much to the general effect.—*Philosophical Magazine*, No. 248.

REDUCTION OF METALS.

It is stated, apparently on good authority, that a French chemist, M. Chaudron-Junot, of Bussy, has succeeded in reducing to the

metallic state, by exceedingly easy means, a great many bodies which have not hitherto been seen in that condition. He classes his substances in two series :—the first comprehending silicium, tantalum, titanium, chromium, tunster, molybdenum, and uranium,—the second embraces magnesium, aluminum, and barium. The metals in the first series are completely inoxidizable, and perfectly resist the action of strong acids ; and some of them are not affected by even the nitro-muriatic acid, which it is well known dissolves even gold and silver. It is expected that these will replace platinum in many of its applications ; their cost, it is stated, being 30 per cent. less than the cost of that metal. The second series are not affected by a dry or moist atmosphere, though they are acted on by acids ; and it is proposed to apply them to many purposes of ornamentation for which silver is now employed. These metals are all white, the degree of whiteness and brilliancy varying from that of platinum to that of the purest silver. The reduction of silicium is said to be beautifully perfect.—*Athenæum*, No. 1205.

ON THE DISTILLATION OF MERCURY BY HIGH-PRESSURE STEAM. BY M. VIOLETTE.

THIS New Process for the Distillation of Mercury consists in immersing the mass to be distilled in a current of the vapour of water, heated from 320° to 400° Centigrade : the vapour acts at once as the heating agent and mechanical agent ; it first heats the metal so as to produce distillation, and then drives before it and draws the mercurial vapour, their production of which it facilitates ; it hastens the distillation, just as a hot current of air increases the evaporation of water ; the aqueous vapours, charged with mercurial vapour, are condensed together in a common refrigeratory ; the metal separates at the bottom of the receiver, while the condensed water occupies the upper part. It is curious to observe the liquid thread which flows from the refrigeratory ; two currents or threads are distinguishable,—an upper one which is water, and below is the mercurial thread ; there is a continuous current of both. No bumping occurs, and the operation goes on as quietly and as easily as the distillation of water.

The apparatus employed by the author in these experiments consists of,—1st, a cast-iron cylindrical retort, receiving the vessel which contains the mercury ; 2ndly, an iron worm, which, being heated, the vapour of water circulates in it, and being heated to a proper degree, enters the retort, traverses it from one end to the other, the mercury being immersed in it ; it then escapes, with the mercurial vapour, and both are condensed in a refrigeratory.

The author gives, in a series of tables, the results which he has obtained by a series of experiments relating to the distillation of mercury, both alone and amalgamated ; he states the quantity of vapour necessary, and the economical advantages of the new process, which he thus details :—

1. *Facility of the Operation.*—Simple ebullition and the distillation of water are substituted for the difficult and dangerous distillation of mercury; in which there is more trouble in managing the fire, more danger of breakage of the apparatus, more difficulty in removing the metal, more wear of the retort; whereas in the new process the temperature is constant and fixed, and much lower than the red heat usually employed.

2. *Economy of Operation.*—One workman alone can manage an apparatus charged with 1000 kilogrammes of amalgam; the new process is adapted even to larger dimensions.

3. *Economy of Fuel* is certain, and practice alone can state the amount of it; no useless expenditure of fuel will occur, since the heat employed will not be greater than required for the distillation of the metal.

4. *Economy of Mercury.*—The distillation of 100 kilogrammes of silver amalgam occasions the loss of two kilogrammes of mercury. There are produced and annually distilled six millions of amalgamated silver: there is therefore a loss of 120,000 kilogrammes of mercury, worth at least one million of francs, which loss the new process avoids.

5. *Public Health.*—In the new process there is no loss of mercury; the mercurial vapour is condensed with the vapour of water: further, in the common operation, mercurial vapour fills the whole of the apparatus, and when it is opened at the close of the operation, the vapour is diffused in the atmosphere; whereas in the new process the vapour has driven all metallic vapour from the apparatus, and there is no danger in opening it. Thus the operation is complete, and the employment of high-pressure steam seems to have effected the long-sought solution of the problem, of perfectly preserving the workmen from the mortal attacks of mercury in the numerous and important uses in which this metal is distilled.—*Comptes Rendus*, Octobre 14, 1850: translated in the *Philosophical Magazine*, No. 252.

ABSENCE OF IRON IN HYDROCHLORIC ACID PREPARED BY PROFESSOR GREGORY'S PROCESS.

Professor Gregory recommended the use of patent salt, as free from iron, to yield a pure acid. But, although an acid free from iron may thus be obtained, I was struck with the fact that the sulphate of soda remaining in the flask had always a yellowish colour. On testing it, I found iron present in the residue in every case. It was therefore plain that even the patent salt was not free from iron, and that the Absence of Iron in the Hydrochloric Acid made from such materials depended on some cause which prevented the perchloride of iron from passing over. This cause, Professor Gregory suggests, may be the low temperature at which the operation is carried on, or the probable effect of an excess of sulphuric acid in preventing the formation of the perchloride of iron. At all events, I found that, even when iron filings, or peroxide of iron, were added to the materials in considerable quantity, no iron could be detected in the hydrochloric acid. This was the case, even when the oil of vitriol contained so much nitric acid as to yield a very dark-coloured product, coloured by free chlorine and nitrous acid.

This observation is practically valuable, since it enables us to obtain, by Professor Gregory's process, perfectly pure and colourless hydrochloric acid from the commonest sea-salt, although it contains a good deal of iron, and thus still further to reduce the cost of a reagent so indispensable as pure hydrochloric acid.

Professor Gregory formerly detected traces of iron in the hydrochloric acid made with the common kitchen salt, which induced him

to use patent salt. This iron may have been carried over as perchloride, in consequence of the distillation having been pushed too far; that is, till the temperature rose sufficiently. Or, as sulphocyanide of potassium was the test employed, the test may have contained a trace of iron. I have tested with galls after neutralising with ammonia, and the other tests usually employed, and could not detect any compound of iron in the acid.—*Jameson's Journal*, No. 96.

ARSENIC IN THE ZINCS OF COMMERCE.

M. SCHAEUFFELE observes, that it is not requisite to insist on the importance of this subject. As Zinc is not only employed in manufactories for culinary purposes and in medico-legal investigations, it has become necessary to determine the relative proportions of arsenic which it may contain. The experiments of the author were made on four specimens of zinc of well-known origin; and he submitted them to the test of two methods generally applied in researches for arsenic,—those of Villain and Jacquelain. The former consists in passing the arseniuretted hydrogen gas through a glass tube heated to redness, and in weighing the metallic arsenic resulting from its decomposition: the process of the latter consists in passing the gas through tubes with bulbs filled with solution of chloride of gold, which it decomposes, giving rise to metallic gold, hydrochloric and arsenious acids.

M. Villain's method gave the following results, as the quantity of arsenic contained in a kilogramme of each of the kinds:—

	gr.
Zinc of France	0·004260
Zinc of Silesia	0·000970
Zinc of Vieille Montagne	0·000620
Zinc of Corphalie	0·000038

M. Schaeuffele also examined ten other commercial samples of zinc, but of unknown origin; and he found the quantities of arsenic comprised between the above-stated limits.

It results, therefore, from these experiments, that the zinc from the mine of Corphalie is the purest of those met with in commerce; the author indeed admits, that, on account of the small quantity of arsenic which it contains, it may be employed in medico-legal researches without previous purification, which cannot be done with the zinc of France without danger, it being the most arsenical of all.—*Jour. de Pharm. et de Chim.*, Avril 1850: *Philosophical Magazine*, No. 245.

NEW AND READY PROCESS FOR THE QUANTITATIVE DETERMINATION OF IRON. BY DR. F. PENNY.

THE author recommends the employment of the chromate and bichromate of potash for the estimation of iron in the common ores of the metal, and especially for the analysis of the clay-band and black band ironstone of this country. He was led to the application of these salts, in the course of some recent investigations on the materials and products of the manufacture of alum from "alum-

shale," in which he was much retarded by the want of a ready method for estimating the oxides of iron. The chromates of potash give very exact results, and possess the great advantage that a much larger quantity of material may be operated on than can be conveniently treated by the usual methods. For practical purposes, the bichromate is to be preferred. The process requires no other apparatus than that commonly used for Centigrade testing. which is familiar to all persons engaged in chemical pursuits. It may be easily and rapidly executed, occupying only a fraction of the time required for the process of estimating iron by precipitation, as the sesquioxide; and it is not interfered with by the presence of alumina and phosphates which usually exist in the ore. The method is based on the well-known reciprocal action of chromic acid and protoxide of iron, whereby a transference of oxygen takes place, the protoxide of iron becoming converted into sesquioxide, and the chromic acid into sesquioxide of chromium.—*Proceedings of the British Association*, 1850.

GOLD OF CALIFORNIA. BY C. S. LYMAN.

The Gold, the past season, has turned out much better than was expected. Many rich deposits in all parts of the mines have been opened. On the middle fork of the Rio de los Americanos, two men recently dug 28,000 dollars in two months. I saw a portion of it in lumps of the size of hens' eggs, and larger. The Mariposa has yielded several similar prizes, and so has the Mokelmes. But for these few fortunate diggers, there are thousands who scarce earn a dollar a day. From the best information I can get, industrious workers have not averaged more than eight or ten dollars a day—some estimate it much lower; multitudes do not pay expenses, particularly clerks, professional men, and others unaccustomed to hard work.

The gold has at last been discovered in place—in veins penetrating quartz beds—on the Mokelmnes, and in the vicinity of the Mariposa and one or two other places. I have this from gentlemen who have seen the veins, and who are reliable witnesses. These veins are of course not worked yet, as it is more profitable to dig the wash gold. One of these veins has been "denounced" (as it is termed) under the Mexican laws, by Mr. Fremont. The working of the innumerable rich veins, which undoubtedly will be opened in the mountains, will constitute an immense and profitable mining business for centuries. I have no fear that the gold, as many imagine, will all be dug out in a year or two.—*Silliman's Journal, Jan.* 1850.

COATING CAST-IRON WITH TIN AND ZINC.

The following is the conclusion of a paper read by M. Sorel before the Paris Academy of Sciences:—All the salts of copper produce nearly the same effect the one as the other. The salts of tin also give good results, when used with the other acids employed in the cleaning of iron—such as the hydrochloric—but in a less degree

than sulphuric acid. Hydrochloric acid, diluted with water marking about 15 degs. Beaume (sp. grav. 1·120), 28 parts; salts of antimony or copper, 2 parts. These proportions are capable of modification; the quantity of copper salts may be increased, or any other salts added, such as sulphate of lead, zinc, or iron, or other salts but little soluble in hydrochloric acid. Hydrate of iron and pyrolignite of iron produce the same good effect. Hydrochloric acid diluted with water in which a salt of copper has been dissolved acquires in a very high degree the property of dissolving the oxide of iron without attacking the metal. This composition has moreover the advantage of effecting the cleaning in a few minutes. It may be seen when the metal is attacked:—1. By the disengagement of gas. 2. By the change which the liquor undergoes in appearance, which, from an opaque olive, becomes limpid and of a blueish colour. 3. By the precipitation of copper on the iron. A small quantity of the salt of copper should in this case be added to the liquor.

PHOSPHORESCENCE OF POTASSIUM.

While speculating on the consequence of the dynamical theory of Heat, Mr. W. Petrie was led to the conclusion that cold Potassium *ought* to be found *luminous;* and farther, that it ought only to be about a *tenth part* as *luminous* as *phosphorus.* On testing this experimentally, with the precautions for sensitive vision which the anticipated feebleness of the light indicated to be necessary, the result was, that on dividing a bit of potassium, (which was quite dry, being protected only by a coating of bees' wax,) the halves showed two *distinctly luminous sections;* the light being about *a tenth* of that from a similar surface of phosphorus, as far as the eye could make the comparison. The light diminished, naturally, as a protecting coating of oxide was formed, but remained just perceptible to the most sensitive sight, as long as half an hour.—*Proceedings of the British Association,* 1850.

NEW GUNPOWDER.

A New Gunpowder has been prepared by M. Augendre, of Constantinople, and reported on to the Academy of Sciences, Paris, by MM. Piobert and Morin, of the following composition:—

Crystallized prussiate of potash, dried	1 part
White sugar	1 part
Chlorate of potash	2 parts

The Report is favourable to its use for artillery; but well knowing the dangerous character of all explosive compounds containing the chlorate of potash, we do not expect much benefit will accrue from its introduction.—*Athenæum,* No. 1185.

ON PYROGLYCERIN. BY M. SOBRERO.

M. Sobrero has given the above name to a compound which he obtained by treating glycerin with a mixture of nitric and sulphuric acids, in the same proportions as for preparing gun-cotton. This

product is liquid, and explodes very violently; its taste is very distinctly bitter, and is a very active poison; two or three centigrammes immediately kill a dog. It is a powerful oxidizer; mixed with nitric acid, it forms a kind of aqua regia. It has not been analysed, but is suspected to contain nitric acid.—*Journ. de Pharm.*, Avril 1850; *Philosophical Magazine*, No. 251.

PREPARATION OF SULPHUROUS ACID. BY M. BOUTIGNY.

THE author having occasion to prepare a large quantity of Sulphurous Acid, advantageously employed a cast-iron apparatus for this purpose in decomposing sulphuric acid by charcoal. In this operation the iron was not at all acted upon. Although many manufacturers have long used similar apparatus for obtaining this acid, and particularly the vessel employed in the preparation of ammonia, M. Boutigny has thought it proper to mention the above result, which may be useful to certain persons, as even the most recent chemical works recommend the preparation of sulphurous acid in glass or earthen vessels, which are always very expensive, and dangerous on account of their fragility.—*Ibid. Philosophical Magazine*, No. 251.

CONDENSATION IN HYDRATED MINERALS.

DR. L. PLAYFAIR has read to the British Association a paper on the Condensation of volume in highly Hydrated Minerals. This paper contains the explanation of a very remarkable law, in virtue of which it appears, that in many solid bodies, which contain water in a state of chemical combination, such a condensation occurs, that they occupy no greater space than the water in them would if frozen into ice.

IDENTITY OF THE EQUISETIC, ACONITIC, AND CITRIDIC ACIDS, AND ON SOME ACONITATES.

M. BAUP observes that doubts existed as to the identity of the pyrogenous, citridic, and maleic acids; in order to decide this question, he extracted the acid from the *Equisetum fluviatile*, and from the *Aconitum napellus*, and compared them with the pyrogenous citric acid, called citridic acid, and with maleic acid.

From the comparative examination which the author made of their properties and several combinations, he has concluded with certainty that the aconitic, equisetic, and citridic acids, are one and the same acid, and that they ought to be called exclusively aconitic acid, whatever may be the source from which they are procured. Maleic acid, although isomeric with it, is not however identical, and ought to retain its name.

In examining several aconitates, M. Baup has met with a fact which merits the attention of chemists, as being the first example of a compound of three atoms of an organic acid with one atom of base. The ter-aconitate of potash and also of ammonia have but very few representatives, even in inorganic chemistry: as an example, the teriodate of potash of M. Serullas may be mentioned.

During these researches on the *Equisetum fluviatile*, M. Baup discovered in it a peculiar yellow crystalline matter, which imparted to aluminated cotton a yellow tint not inferior to weld. He has given it the name of *flavequisitin.—Comptes Rendus*, Sept. 9, 1850: *Philosophical Magazine*, No. 251.

PURIFICATION OF OIL OF VITRIOL FROM NITRIC ACID.

For the removal of the Nitric Acid from Oil of Vitriol, either of the two following methods may be adopted:—

1. Three volumes of the acid are to be mixed with one of water, and sulphurous acid transmitted through the liquid until it smells strongly: it is then to be boiled till all odour of sulphurous acid has disappeared.

2. Instead of diluting the acid with water, the same bulk of a saturated solution of sulphurous acid may be used, which has the advantage that a supply of the solution may be kept for use when required.

In preparing an acid free from lead, as well as nitric acid, it will be found necessary to dilute the oil of vitriol with half its bulk of water. As sulphate of lead is slightly soluble in oil of vitriol of specific gravity 1·715, mixed with half its bulk of water, its density is about 1·650. The oil of vitriol used in these experiments was from one of the first manufactories in the country, and had a specific gravity of 1·835.—*Communicated by Mr. A. Kemp to Jameson's Journal*, No. 96.

COMPOUND OF NITROGEN AND BORON.

Prof. Wöhler procures a combination of Nitrogen and Boron (having the appearance and properties of the substance discovered by Balmain, to which he gave the name of Œthogen) by heating to redness one part of anhydrous borax with two parts of dried sal-ammoniac in a platinum crucible. The compound is a light white powder, which, in a current of steam, is converted at a low red heat into boracic acid and ammonia. Heated with anhydrous carbonate of potash, borate and cyanate of potash are formed: $BN + 2 (KO CO_2) = KO,BO_3 + KO, C_2 NO$. In the analysis of the substance, the nitrogen was determined as ammonia by heating with soda-lime, and the boron by oxydation with a weighed quantity of nitrate of lead. The excess of weight (after ignition) above that of the oxide of lead formed is boron. The numbers of the analysis agreed with the formula $BO_3 + 14 BN$. The author concludes the boracic acid to be an accidental admixture.— *Proceedings of the Chemical Society.*

TO MAKE CHLOROFORM.

Meurer's Process.—Chloride of lime, 5 kilogrammes; water, 15 kilogrammes; alcohol at eighty per cent., 500 grammes. The chloroform is mixed with a sufficient quantity of milk of lime to remove all traces of chlorine, and then rectified. From 150 to 180 grammes of pure chloroform are thus obtained. If a stronger alcohol or a larger proportion be employed, the product is less. Four distilla-

tions made with the above proportions, but varying the quantity of chloride of lime employed, yielded—1. 1·153·50 gram.; 2. 112·00 gram.; 3. 116·00 gram.; 4. 112·00 gram.

Carl's Process.—Chloride of lime, 5 kilogrammes; water, 9 kilogrammes; alcohol, 84 per cent., 1200 grammes. Mix the whole in the still, and after standing about twelve hours heat moderately, so as not to exceed 75° C., equal to 167 F. In about three hours the chloroform passes over, and the distillation is finished in half an hour. The mean of 17 preparations gave a product of 285 grammes.

M. Siemmerling's Process.—This process, which furnishes the largest proportion of Chloroform compared with the quantity of alcohol employed, is as follows:—Chloride of lime, 8 parts; caustic lime, 1 part; alcohol, 1 part; water, 40 parts. M. Siemmerling has also experimented with acetone, but did not find the process advantageous, the product not being more than one-third that of the acetone employed:—Acetone, 30 grammes; chloride of lime, 150 grammes; water, 5 kilogrammes. Chloroform prepared with wood naphtha always contains a substance which is blackened on the addition of sulphuric acid: 50 grammes of wood spirit give 6 grammes of chloroform.

THE DIAMOND UNDER THE VOLTAIC ARC.

Mr. J. P. Gassiot, F.R.S., the well-known electrician, has read to the British Association a paper on "a peculiar Form produced in a Diamond under the influence of the Voltaic Arc." He exhibited to the Section a diamond which had been exposed to the intense heat produced by the voltaic battery when arranged as in the device for the electric light. The diamond had apparently been fused; but instead of changing into coke, as in such circumstances diamonds generally do, it had become a glassy mass, and seemed to consist of a multitude of small crystals adhering to each other. The diamond was examined with much interest and curiosity.

TRIMORPHISM OF CARBON.

Mr. H. C. Sorby, F.G.S., has read to the British Association a paper on "the Trimorphism of Carbon;" the object of which was to establish the fact that coke was in reality crystallized when very hard, and in the same form as the diamond, from which, however, it was stated to differ in crystallographic volume. Mr. Sorby stated that he had also observed anthracite or blind-coal in the form of crystals, belonging to the square prismatic system.

ON OZONE. BY M. SCHÖNBEIN.

Ozone acts powerfully on most metals, causing them to assume their maximum of oxidizement; the action commences at 32°. It combines directly with olefiant gas without decomposition: it destroys sulphuretted and seleniuretted hydrogen, &c., and converts sulphurous and nitrous acids, &c. into sulphuric and nitric acids.

Ozone precipitates peroxide of lead from an alkaline solution

of lead, or from the acetate. It rapidly decomposes all the salts of manganese, whether in the solid state or in that of solntion, producing peroxide. Hence it results that a strip of dry paper impregnated with sulphate or chloride of manganese is a reagent for ozone; the paper becoming rapidly brown in an ozonized atmosphere. Another and very sensible reagent, which M. Schönbein prefers, is a strip of starched paper containing a very small quantity of iodide of potassium. A solution of yellow ferrocyanide of potassium is changed by ozone into red cyanide. A great number of metallic sulphurets are rapidly converted by this substance into sulphates: such are the sulphurets of iron, lead, copper, and antimony.

According to M. Schönbein, ozone is the most powerful oxidizing agent in nature. As ozone is invariably formed in the air by the action of artificial electrical discharges, it should also be produced throughout the atmosphere, in which natural electrical discharges occur. Nothing is easier than to demonstrate the presence of ozone in the atmosphere, and the variations of the quantities produced, by means of the test papers described. In general the reaction is greater in winter than in summer. M. Schönbein has always observed, that during a fall of snow it is much greater than at any other time. An exposure of iodized and starched paper for two hours is sufficient to render it of a deep blue colour; whereas the same air, enclosed in a receiver, produces no effect.

It may be inquired whether the nitric acid which is formed by passing electric sparks through air, as first observed by Cavendish, and also that produced during storms, is due to the direct action of electricity on oxygen and nitrogen, or to that of ozone on nitrogen.

Such are the general properties of a substance the composition of which has hitherto escaped all methods of analysis, and which M. Marignac considers as a peculiar modification of oxygen, which increases its chemical affinities. M. Schönbein regards it as a compound, probably containing more oxygen than oxygenated water. But these are merely hypotheses which require the sanction of fresh experiments. Opinions as to the nature of this substance should not yet be pronounced.—*Comptes Rendus*, 14 Janvier, 1850.

PROPERTIES OF PEAT-CHARCOAL.

We have before us (says the *Athenæum*, No. 1185) a pamphlet by Mr. Rogers, in which the merits of Peat-charcoal, not merely as a deodorizer, but as a disinfectant, are strongly insisted on. In speaking of the gases accumulating in the sewers of the metropolis, it is stated that "Science at present knows no means for destroying those gases;" whereas the merest tyro in chemistry could name a dozen preparations by which they might be decomposed or absorbed. The absorptive power of charcoal is not a new discovery: for Saussure ascertained that the rate of absorption for several gases was as follows:—

Ammoniacal gas..............	90 times its volume.		
Sulphurous acid..............	65	"	"
Sulphuretted hydrogen	55	"	"
Carbonic acid................	35	"	"
Carburetted hydrogen........	35	"	"

Peat charcoal cannot under any circumstances absorb a larger volume of either of these gases than the above ; but a glimpse at the table will convince any one that it may be employed as a *deodorizer* with very great advantage in virtue of this peculiar property,—and Mr. Rogers deserves great praise for having called public attention to the importance of an agent which can be obtained, as it appears from his statement, at a moderate cost. It must, however, be always borne in mind that it by no means follows because excretory matter is deprived of smell that it is robbed of those principles which are the cause of disease. No greater mistake than this can be committed, and it is most important that it should be corrected without delay. We are satisfied that the annoying odours which arise from decomposing animal and vegetable matter are our great safeguards, since these compel the speedy removal of the putrefying mass from the neighbourhood of our dwellings. Rob it of its smell, and masses of organic matter will be pouring forth their subtile *fever-agencies* unnoticed by us until pestilence proclaim the fact. Charcoal probably has some disinfectant powers, apart from its antiputrescent and deodorant properties,—but of this we want the proof. Nature has given a peculiarly noxious odour to all exhalations from putrefying matter, by means of which we learn by our sense of smell their presence :—let us not hastily attempt to destroy a property established for an important end.*

PRESENCE OF FLUORINE IN BLOOD AND MILK.

In 1846, Dr. G. Wilson announced to the Royal Socity of Edinburgh, that after finding that fluor spar was soluble in water, and occurred in many natural waters, he thought it well to seek for it in milk and in blood, and found distinct evidence of its presence in both. This summer, however, Dr. Wilson has employed the fresh-drawn blood of the ox. About 26 imperial pints or 3 gallons of blood were made use of. From the large scale on which the experiment was conducted, and the simplicity of the process followed, the evidence in favour of the presence of fluorine in the blood of the ox seems unexceptionable ; and it cannot be doubted that the blood of other animals will be found to contain the same element. Dr. Wilson presumes it to be present in the state of fluoride of calcium, and that its amount is very small. Milk was examined in a similar way, with nine imperial pints of rich milk from a country farm. The vapour which they evolve etched glass distinctly. The ashes of 12 lb. of new skim-milk cheese made this spring treated in the same way occasioned deep etching of glass. The ashes of four imperial pints of whey treated in the same way have barely marked glass so

* See *Year-book of Facts*, 1850, page 212, for Lord Ashley's statement, upon the authority of Mr. Owen ; and a close examination of the question.

as to show the faintest outlines when breathed upon. In all probability the fluoride of calcium is associated with the phosphate of lime, and when milk is coagulated separates along with the caseine. Dr. Wilson also stated that he had repeated the inquiry into the solubility of fluoride of calcium in water, reported to the British Association at its Southampton meeting, and with the same result, viz., that 16 fluid ounces, or 7,000 gr. of water, at 60°, dissolve 0·26 gr. of fluor spar.—*Proc. Brit. Assoc.* 1850; *Athenæum*, No. 1190.

PRESENCE OF CARBONATES IN BLOOD.

A PAPER on this subject has been read to the British Association, by Professor G. J. Mulder, of Utrecht; the intention being to show experimentally that blood contains carbonic acid, not merely in solution, but also in chemical combination with bases and organic substances,—as globulin, albumen, &c.

ON A COMPOUND OF IODINE AND CODEINE, BY T. ANDERSON, M.D.

THE Compound of Iodine and Codeine which forms the special subject of this communication is obtained by mixing together alcoholic solutions of equal quantities of Codeine and Iodine, and leaving the mixture to spontaneous evaporation, when the new compound is deposited in crystals. This compound is insoluble in water, sparingly soluble in cold alcohol, but readily in boiling, and it is again deposited in small triangular plates as the solution cools. Its crystalline form has been determined by Professor Haidinger, of Vienna, who finds it to belong to the doubly oblique system. The crystals have a fine diamond lustre and a deep purple colour by reflected, and ruby red by transmitted light. In powder its colour is cinnamon brown.—*Proceedings of the British Association*, 1850.

ON THE PRESENCE OF SUCCINIC ACID IN THE HUMAN BODY. BY M. W. HEINTZ.

ON examining the colourless liquid contained in hydatic cysts, which are frequently developed in the liver, and sometimes even in the muscles, the author discovered that this liquid contains appreciable quantities of succinate of soda. M. Heintz has examined this liquid extracted from the liver of a woman; and by evaporating it to dryness the residue containing crystals of common salt was mixed with alcohol, which occasioned the separation of a thick syrup; the alcoholic solution did not appear to contain urea, creatin, or uric acid; when evaporated to a syrupy consistence, it at first deposited crystals of common salt, and afterwards some feathery crystals, which were purified by dissolving in a small quantity of water a precipitation from it by concentrated alcohol. The aqueous solution of these crystals, treated with hydrochloric acid, deposited small crystals of an organic acid, slightly soluble in cold water. On attentively examining these crystals, M. Heintz ascertained that they were identical with succinic acid; the experiments first performed were merely qualitative, but they were afterwards completed by the

elementary analysis, of a small quantity certainly, of these crystals. The form of these crystals, moreover, was that of an oblique rhombic prism; and M. Heintz found, by very exact admeasurements, that the angles of these crystals were equal to those of pure succinic acid. These experiments sufficiently demonstrate the interesting fact announced by the author relative to the existence of succinic acid in the animal economy.—*Journ. de Pharm. et de Chim.*, Sept. 1850: translated in the *Philosophical Magazine*, No. 252.

INFLUENCE OF CARBONIC ACID ON THE GROWTH OF FERNS.

Dr. Daubeny has read to the British Association, a statement that the inquiry on this subject was still in progress, and that no satisfactory results have as yet been arrived at. The Ferns were now growing in an atmosphere containing one per cent. of carbonic acid in excess above that ordinarily contained in air; and although it was thought similar ferns growing under the same conditions, but without carbonic acid in excess, were the most luxuriant, it appeared that they thrived well in this artificial atmosphere. Mr. R. Hunt stated that he found the diversified influences of light materially to affect the quantity of carbonic acid which the plants could absorb without immediate injury.

ON HUMUS.

Humus, the brown-coloured powder from the decomposing trunks of old trees, has been examined by M. Soubeiran, who says: "as to the nitrogen, which is always one of the constituents of Humus, it is impossible to say what proportion belongs to it, and what proportion enters into the nitrogenous products which are mixed with it. It is to be observed, that, in the powder of oak used, the quantity of nitrogen is greater than in the wood which gave rise to it. This fact renders it probable that some of the nitrogen of the air is fixed in it during the decomposition of the wood; this was the opinion of Theodore de Saussure. It may be argued, that the remains of insects have supplied it; but for a long period this powder could have afforded them no shelter, since the slightest shock causes it to fall at the root of the tree.—*Journ. de Pharm. et de Chim.*, May, 1850; *Philosophical Magazine*, No. 245.

ON ALOINE, THE CRYSTALLINE CATHARTIC PRINCIPLE OF BARBADOES ALOES.

About two months ago, Dr. Stenhouse, F.R.S.L. & E., received from his friend Mr. Thomas Smith, apothecary, Edinburgh, a quantity of a brownish-yellow crystalline substance which he had obtained from Barbadoes Aloes. Mr. Smith's process consisted in pounding the previously dried aloes with a quantity of sand, so as to prevent its agglutinating; macerating the mass repeatedly with cold water, and then concentrating the liquors *in vacuo* to the consistence of a syrup. On remaining at rest in a cool place for two or three days, the concentrated extract became filled with a mass of

small granular crystals of a brownish-yellow colour. This is the crude substance to which Mr. Smith has given the name of Aloine, and which appears to constitute the cathartic principle of aloes. The brownish-yellow crystals obtained in this way are contaminated with a greenish-brown substance, which changes to brownish-black on exposure to the air, and still more rapidly when it is boiled. In order to purify the crystals of aloine, therefore, they must first be dried by pressure between folds of blotting-paper, and then repeatedly crystallized out of hot water till they have only a pale sulphur-yellow colour. The aqueous solutions of aloine must on no account be boiled, but simply heated to about 150° F., as at 212° F. aloine is rapidly oxidized and decomposed. By dissolving the purified crystals of aloine in hot spirits of wine, they are deposited, on the cooling of the solution, in small prismatic needles arranged in stars. When these crystals have a pale yellow colour, which does not change when they are dried in the air, they may be regarded as pure aloine. It is quite neutral to test-paper. Its taste is at first sweetish, but soon becomes intensely bitter.

It has long been known to medical practitioners, that the aqueous extract of aloes is by far the most active preparation of that drug. The reason of this is now very plain, as the concentrated extract of aloes obtained by exhausting aloes with cold water consists chiefly of aloine, by much the larger portion of the resin being left undissolved. Mr. Smith states that, from a series of pretty extensive trials, from 2 to 4 grains of aloine have been found more effective than from 10 to 15 grains of ordinary aloes. Aloin is, Dr. Stenhouse thinks, therefore likely, ere long, to supersede, at least to a considerable extent, the administration of crude aloes.—See Dr. Stenhouse's communication to the *Philosophical Magazine*, No. 253.

WATERY SECRETION OF THE LEAVES AND STEMS OF PLANTS.

MOST botanists who have directed their attention to the subject, have been of opinion that the Watery Secretion of Plants is nothing but pure water. Dr. Völcker, of the Royal Agricultural College at Cirencester, has carefully investigated this curious subject: and, in comparing the secretion of the leaves of the ice-plant with the fluid in the ascidia of *Nepenthes*, finds a material difference in their respective compositions, as will be seen by the annexed table, which exhibits the composition of both fluids:—

Composition of the fluid in the ascida of Nepenthes.	*Composition of the watery secretion of the leaves of* Mesembryanthemum crystallinum.
Organic matter, chiefly malic and a little citric acid.	Organic matter (albumen, oxalic acid, &c.)
Chloride of potassium.	Chloride of sodium.
Soda.	Potash.
Lime.	Magnesia.
Magnesia.	Sulphuric acid.

ON THE EXISTENCE OF IODINE IN FRESHWATER PLANTS. BY M. AD. CHATIN.

In verifying the fact stated by Muller (Lindley's *Vegetable Kingdom*), of the existence of Iodine in a cress of unknown origin, the author has ascertained—

That iodine exists in freshwater cresses, that it is not peculiar to this species, nor general with respect to plants of the family of the Cruciferæ;

That iodine does not exist, or at any rate cannot be discovered in, terrestrial plants, whereas it exists in all aquatic plants;

That of the latter, those which occur in running water are richer in iodine than those of stagnant water;

That in sheets of water, which are sufficiently large to be strongly agitated by winds, the plants approach those of running water, in the quantity of iodine which they contain;

That the proportion of iodine contained in plants is in general independent of their nature, and subordinate only to their habitat, as indicated by the Confervæ, the Potamogetons, the Nymphæa, the Ranunculi, and the Cresses, all of which are equally rich in iodine in running waters, and equally poor in marshes;

That the iodine exists uncombined with the tissue, but in the state of alkaline iodide in the juice of the plant.—*Comptes Rendus*, Mars 25, 1850.

ON THE EXISTENCE OF IODINE IN BEET-ROOT.

After the discovery of the existence of so important a substance as Iodine in so many bodies, M. Lamy thought it might be interesting to state how he had ascertained its presence in the Beet-root of the Grand Duchy of Baden.

In November, 1849, M. Lamy received from M. L. Lintz, chemist at the sugar manufactory of Waghausel in the Grand Duchy, a specimen of beet-root potash for examination, thinking that it contained iodine.

Some fragments were accordingly dissolved in distilled water and saturated with nitric or sulphuric acid; the solution was of a yellow colour and exhaled the odour of iodine; by the addition of solution of starch it became of an intense blue colour, which disappeared by heat and reappeared on cooling.

After frequently repeating this experiment, and being certain of the existence of an alkaline iodide in the potash of Waghausel, M. Lamy examined successively the various products of the manufacture of sugar of this locality, beginning with saline matter, molasses, then taking the refined sugar, unrefined sugar, and *cossettes*, or beet-root cut into small parallelopipeds and dried.

The saline matter was treated with hot water as long as it dissolved anything; the aqueous solution was evaporated to dryness, and the residue treated with highly rectified alcohol, the solution being evaporated to dryness; the residue was divided into two portions; one of these was treated with sulphuric acid and solution of

starch, and the other was tried by M. Reynoso's process; in both cases the existence of iodine was evident.

The ash of the molasses was boiled in distilled water; a portion of the filtered liquor, saturated with nitric or sulphuric acid, gave, like the potash, a fine blue colour on the addition of solution of starch; another portion, on spontaneous evaporation, left a crystallized residue which was treated with hot alcohol of 40 degrees to dissolve the iodide and separate the foreign salts insoluble in it. The alcoholic solution was evaporated to dryness, and the residue treated with water yielded a solution which gave a deep blue colour with starch. This colour was very permanent, disappeared on being heated, and reappeared on cooling.

The same treatment was followed with sugar unrefined and refined, but they gave not the least trace of iodine; the cossettes, on the contrary, contained this substance: the experiment was several times repeated, and always with the same result.

The author examined the beet-root from a manufactory in the neighbourhood of Versailles, but he discovered no trace of iodine in it. As the manufactory of Waghausel is of great extent, M. Lamy thinks it probable that all the beet-root used in it may not contain iodine; and as salts of iodine are not uncommon in the salt-springs of Germany, he inquires, without attempting to decide, whether the presence of iodine may not be derived from the assimilation of the salts of iodine.—*Journ. de Pharm. et de Chim.* Juillet, 1850.

MELSENS'S NEW PROCESS FOR EXTRACTING SUGAR FROM THE CANE.

M. MELSENS has employed the acid sulphites, and more especially the bisulphite of lime, for the double purpose of preventing fermentation by the action of the sulphurous acid, and of neutralising the sulphuric acid as fast as it is formed by means of the lime. The results are, that bisulphite of lime can be employed in the extraction of sugar:—1st, as an antiseptic, preventing the production and action of any ferment; 2nd, as a substance greedy of oxygen, opposing any alteration that might be caused by its action on the juice; 3rd, as a clarifier, coagulating at a temperature of 212° all albuminous and other coagulable matters; 4th, as a body bleaching all pre-existing coloured products; 5th, as a body opposing itself in a very high degree to the formation of coloured substances; 6th, as a base capable of neutralising any hurtful acids which might exist or be formed in the juice, and substituting in their place a weak inactive acid, namely, sulphurous acid.

M. Melsens is of opinion that sugar can be obtained from the sugar-cane with no other source of heat than a tropical sun, excepting only for the purpose of clarification; indeed, the bisulphite of lime prevents the crude juice of the cane, or the syrup obtained therefrom, from undergoing any changes: great rapidity in the process of crystallization, indispensable at present, becomes by using this salt unnecessary; and more than this, the quantity of sugar which is now lost in the bagasse, in consequence of the impossibility

of washing it out unchanged, can be all collected by being dissolved in water charged with bisulphite of lime.

The only objection that can be made to the above process is, that the sugar obtained by means of bisulphite of lime has a sulphurous taste: this is true, but the taste is completely lost—1st, by crushing the sugar and exposing it to the air, whereby the little sulphite of lime which there may be is converted into a tasteless sulphate: 2nd, by exposing the sugar to an atmosphere containing ammonia: if this is done, the sugar acquires a very agreeable flavour of vanilla, but is apt to become a little discoloured: 3rd, by clarifying it until it loses 10 per cent. of its weight: by this process a pure white sugar can be obtained, which will bear comparison with any sample produced at present. The last is the process recommended to be used on a large scale. The quantity of sugar fit for the market which can be obtained from the sugar-cane by adopting bisulphite of lime, as above recommended, is at least double that obtained by the usual processes.

In consequence of M. Melsens having made all his experiments on the sugar-cane at Paris, and therefore on a small scale, he is not able to state how bisulphite of lime can best be used in the large colonial sugar manufactories; but is compelled to leave the application of the principles on which his method depends to the intelligence of the manufacturers themselves.*

In the preparation of beet-root sugar, bisulphite of lime is quite as useful as in the extraction of cane-sugar. The way in which it is to be employed in the former is fully explained in the second article published in the 507th number of the *Courrier de l'Europe.—Gardener's Chronicle*, Dec. 15, 1849.

DR. SCOFFERN'S SUGAR-REFINING PROCESS.

It will be recollected that this new Process was described by Dr. Scoffern at the Meeting of the British Association in 1849; and is duly recorded in the *Year-book of Facts*, 1850, p. 101.

At the recent Meeting of the Association at Edinburgh, Dr. Scoffern detailed the Process as now in operation at Montril, about 45 miles south of Granada, on the southern coast of Spain, in a manufactory furnished with apparatus of the rudest character. "Up to this period (July 9)," says Dr. Scoffern, "our own vacuum apparatus has not been sufficiently advanced to enable us to pursue our operations by its aid; nevertheless, owing to the superior defecating power of the sub-acetate of lead, we have, even with the old and rude machinery, obtained a result of more than 16 instead of 7 per cent. of sugar. Our striking teaches, or final evaporating pans, we were under the necessity of removing, in order to afford the requisite space for our own machinery; hence we were under the necessity of concluding our process of concentration in a brass pan

* The employment of this process in Jamaica is noticed at page 101 of the present volume.

of conical form, and holding about 600 imperial gallons,—thus materially increasing the difficulty of the evaporative process. Hitherto only one-sixth per cent. on the juice of sub-acetate has been used, but I imagine the quantity may be advantageously increased. As filtration is indispensable for the conducting of this process, considerable fear was entertained lest fermentation might supervene. This fear, however, practice has demonstrated to be groundless, inasmuch as we possess in sulphurous acid an agent most antagonistic to fermentation. Another speculative fear was, lest danger might arise from the lead employed: this fear, too, practice demonstrates to be entirely without foundation, for not only is the sulphite of lead most easily removed, but even were it to remain no injury could supervene, inasmuch as this agent is as harmless as chalk."

In continuation of this subject, some Observations on the Sulphite of Lead were made by Dr. Gregory, who stated that he had made experiments on the sulphite formed in this process. The Doctor admitted that an infinitely small proportion might still remain in the sugar, but that he considered it quite innocuous. He had, indeed, fed rabbits and dogs with food which had been united with this sulphite of lead, and the result was that they thrived amazingly, showing no symptom of any of the known effects of lead. Dr. Gregory also remarked that, in testing sugar for lead with the hydro-sulphuret of ammonia, iron was often mistaken for the former metal.

Dr. Christison contended that we had no evidence that the sulphite of lead was innocuous. It was true that in cases of poisoning by carbonate of lead, sulphuric acid was administered to convert it into the comparatively insoluble sulphate; but this was a case widely different from the slow accumulation of lead upon the system. Dr. Christison adduced some examples of exceedingly small doses of lead being taken in water for more than twelve months before its evil effects became apparent. He therefore thought it yet remained to be proved that the sulphite of lead was without action on the system, since we know nothing of the influence of the solvents it would meet with in the system, or of the influences of vital action. Rabbits, he was prepared to say, should be entirely rejected in these inquiries, since he had found that they were not affected by many poisons. Dogs and cats were the only animals which could, from their internal structure, be regarded as the representatives of the human system in these investigations.—*Abridged from the Athenæum*, No. 1189.

SEA-WATER MADE DRINKABLE BY FILTRATION.

M. CARDAN has described to the Paris Academy of Sciences, a new system of Filter, intended to render sea-water drinkable. This apparatus consists of a syphon, the long tube of which is filled with powdered charcoal. The author states that the sea-water, after having traversed this syphon, has lost its nauseous savour, and that the saline taste which remains is scarcely to be detected after it is

mixed with wine. MM. Becquerel and Pouillet are appointed commissioners to examine into the merits of this communication.—*Athenæum*, No. 1185.

ARSENIC IN CHALYBEATE SPRINGS.

Since the discovery of Arsenic in the deposits from certain Chalybeate Springs, it has been asked whether the poisonous properties of this substance are not neutralized by the state in which it is found. M. Lassaigne has finished a series of experiments connected with this subject, for the purpose of ascertaining the proportion of arsenic contained, in what state of combination it exists, and the nature of the action which these arseniferous deposits exert in the animal economy. The following are M. Lassaigne's conclusions:— 1. In the natural deposits of the mineral waters of Wattviller, arsenic exists to the amount of 2·8 per cent. 2. A portion of these deposits, representing 1·76 grains of arsenic acid, or 1·14 grains of arsenic, produced no effect upon the health of a dog. 3. This non-action shows that the poisonous property of the arsenic is destroyed by its combination with the peroxide of iron, and thus confirms what has been before asserted,—that peroxide of iron, by combining with arsenious and arsenic acid, destroys their poisonous properties, and consequently becomes an antidote for them.

ACTION OF THE SOAP TEST UPON WATER.

A paper has been read to the British Association, by Mr. D. Campbell, "On the action of the Soap Test upon Water containing a salt of magnesia only, and likewise upon water containing a salt of magnesia and a salt of lime." This was an examination of the value of the soap test of Dr. Clarke. The conclusions arrived at were— 1st. That water containing sulphate of magnesia alone acts towards the soap test in producing with it a perfect lather, similarly or nearly so, as does water containing a lime salt alone, but only when the equivalent of magnesia salt does not exceed six grains of carbonate of lime in a gallon of water. 2d. That the degrees of hardness of an ordinary water cannot be inferred by the rule. Compute the grains of lime, magnesia, oxides of iron and alumina, in a gallon of water, each into its equivalent of chalk. The sum of these equivalents will be the hardness of the water. 3d. That the degrees of hardness of a water containing magnesia and lime salts, as shown by the soap test as it is now applied, cannot in every case be taken as representing the amount of these salts in the water; nor in nearly any instance can it be considered as giving the amount of lime in a water when magnesia is present. 4th. That water might show by the soap test a small degree of hardness in comparison to the considerable quantities of salts of magnesia and of lime it might contain: and trusting to this method of analysis alone, when selecting water for ordinary use and for steam purposes, might lead to a water being adopted which might not be conducive to the general health, and which would leave considerable deposit in vessels in

which it was boiled—a great deterioration to its use in steam-generating.

ON THE ALTERATION WHICH WELL-WATER UNDERGOES. BY M. T. BLONDEAU.

THE analysis which the author has performed on the Water of a great number of the Wells of Rhodez, has led him to adopt the following conclusions :—

1. Well-water may be altered by two causes ; by the presence of mineral salts held in solution, and by that of animal matters.

2. The mineral substances which occur in solution are silica, alumina, carbonates and phosphates of lime and magnesia, potash-alum, chlorides of calcium, magnesium, and sodium, with nitrates of the same bases. These different substances are not hurtful to the animal economy when they exist only in small quantity. Well-water, [? of which a litre] contains only 4 to 5 centigrammes of these substances in solution, may be employed for all domestic uses, provided it does not contain too large a proportion of animal matter.

3. Water, of which a litre contains one gramme of the above-mentioned substances, may still be good for drinking; but it is not fit for cooking vegetables or washing linen when it contains 0·1 grm. of lime or magnesia.

4. Water, of which a litre contains 0·1 grm. of lime or of magnesia, and 0·1 grm. of organic matter, is improper for any domestic use.

5. It is of the utmost importance to state the existence and determine the quantity of animal matter held in solution in waters; for, if they exceed the limits above stated, they act disastrously on the economy, and may occasion dysentery and various maladies which appear to be contagious because the whole population acquire the seeds at the same sources.

6. The presence of magnesia in drinkable waters does not produce so hurtful an action as supposed by some persons. The well water of Rhodez contains, on an average, five times as much magnesia as the waters of the valley of the Iser, analysed by M. Granger ; and yet endemic diseases, as goître and cretinism, are entirely unknown in the chief town of Aveyron.

7. The water of certain wells possesses a very disagreeable earthy taste : this taste is derived from alumina held in solution by carbonic acid. It is observed that those well-waters which contain most of this base have the strongest earthy flavour.

8. It results from these experiments, that a classification of drinkable waters, based on the relations which exist between the sulphates and the chlorides, must be a defective one : for this relation varies, with respect to the same kind of water, within limits of considerable extent; and it is never certain that the water operated on has not met in its course, either above or below the soil, with substances which have altered and changed the proportions in which these salts enter into its composition.—*L'Institut*, No. 851: *Philosophical Magazine*, No. 251.

ON THE AIR AND WATER IN TOWNS, AND THE ACTION OF POROUS STRATA ON WATER AND ORGANIC MATTER. BY DR. R. A. SMITH.

It is a matter of great importance to find from what source it is best to obtain water for large towns, and how it is to be collected. To these points Dr. Smith particularly directs attention. Regarding the conditions of many springs, which never become muddy, but possess a constant brilliancy and a very equal temperature at all seasons of the year, the author thinks that there is a purifying and cooling action going on beneath. The surface water from the same place, even if filtered, has not the same brilliancy; it has not the same freedom from organic matter, neither is it equally charged with carbonic acid or oxygen gas: there are other influences, therefore, at work. The rain which falls has not the purity, although it comes directly from the clouds; it may even be wanting in cleanness, as is often the case. Springs rise through a great extent of soil, and collect a considerable amount of inorganic salts; and it is shown by Dr. Smith that their purity is due entirely to the power of the soil to separate all organic matter, and at the same time to compel the absorption of carbonic acid and oxygen. The amount of organic matter removed in this way, by its combination with oxygen, is surprising, and it is a most important and valuable property of the soil. The change even takes place close to cesspools and sewers; at a very short distance from the most offensive organic matter there may be found water having little or none in it. As an agent for purifying towns, this oxidation of organic matter is the most extraordinary, and we find the soil of towns which have been inhabited for centuries still possessing this remarkable power. St. Paul's Churchyard may be looked upon as one of the oldest parts of London, yet the water from the wells around it is remarkably pure, and the drainage of the soil is such that there is very little of any salts of nitric acid in it. If the soil, says Dr. Smith, has such a power to decompose by oxidation, we want to know how it gets so much of its oxygen. We must, however, look to the air as the only source, and see how it can come from it. When water becomes deprived of oxygen, it very soon takes it up again,—as may be proved by experiment. This shows us that as fast as the oxygen is consumed by the organic matter it receives a fresh portion, conveyed to it by the porous soil. Several experiments of the following character were given, to show the filtering power of the soil:—A solution of peaty matter was made in ammonia; the solution was very dark, so that some colour was perceived through a film of only the twentieth of an inch in thickness. This was filtered through sand, and came out perfectly clear and colourless. Organic matter dissolved in oil of vitriol was separated from it by a thickness of stratum of only four inches. A bottle of porter was by the same process deprived of nearly all its colour. The material of which this filter is made is of little importance; one of the best, according to Dr. Smith, as far as clearing the water is concerned, being of steel filings,—oxide of iron, oxide of manganese, and powdered

bricks, all answering equally well. This shows that the separation of the organic matter is due to some peculiar attraction of the surfaces of the porous mass presented to the fluid. This paper is a continuation of Dr. Smith's Report, published in 1849 * ; and he purposes continuing the inquiry.—*Proceedings of the British Association*, 1850 : *Jameson's Journal*, No. 98.

DEODORIZING EFFECTS OF CARBON. BY PROFESSOR SCHÖNBEIN.

1. When ordinary charcoal powder is agitated, even but for a few minutes, with an aqueous solution of perfectly pure perchloride of iron, the latter, when filtered, strikes a deep blue colour with ferridsycnide of potassium, showing that under the above circumstances protochloride of iron is formed. When a definite quantity of the solution of the perchloride is treated long enough, and with a sufficient quantity of charcoal powder, the whole of the perchloride is converted to protochloride. This change is effected the more quickly the finer the charcoal is powdered, on which account calcined lamp-black is far more effective than ordinary charcoal powder. It deserves to be mentioned that even pulverised coke produces a similar effect upon the salt of iron.

2. The sulphate, nitrate, and acetate of peroxide of iron, dissolved in water, are completely converted into protosalts by agitation with charcoal powder; whence we are led to conclude that all persalts of iron dissolved in water, or in any other menstruum, may be converted by carbon, even without the assistance of heat, into protosalts.

With respect to the behaviour of carbon towards a solution of the pernitrate of iron, the following statements may be mentioned:—If the solution is so dilute that it appears of a light yellowish-brown colour, and it is shaken for a few minutes with charcoal powder, the filtered liquid is of a much darker colour than the original solution. After further brief treatment with fresh charcoal, the colour of the solution becomes much darker; and, after a third or fourth operation of the same kind, the liquid appears almost colourless, in which case it now contains no longer a trace of the persalt of iron, but only protosalt. This darkening of the colour arises from the charcoal removing not only oxygen from the solution of the persalt of iron, but some nitric acid at the same time; which gives rise to the formation of basic pernitrate of iron—the cause of the dark colour.

3. When the solution of the ferridcyanide of potassium is shaken only for a few minutes with ordinary charcoal powder, the filtered liquid strikes a pretty deep blue colour with perchloride of iron, or the solution of any other persalt free from protoxide. The same solution agitated for a sufficient time, and with a sufficient quantity of charcoal powder, is so changed, that it furnishes a copious dark blue precipitate with a solution of a persalt of iron, or leaves on evaporation a yellowish residue, which I have not yet been able to

* For which see *Year-book of Facts*, 1849, p. 174.

examine more closely, but which appears to consist, for the greater part, of ferrocyanide of potassium.

Regarding the dissolved ferridcyanide of potassium as a double salt, consisting of prussiate of potash and prussiate of the peroxide of iron, and the dissolved ferrocyanide of potassium as prussiate of protoxide of iron and potash, the above effect of the carbon might be explained from a conversion of the per- into the protoxide of iron.

4. A solution of the perchloride of mercury, agitated sufficiently long with a suitable quantity of charcoal powder, is rendered tasteless, and incapable of furnishing peroxide of mercury, with solution of potash. The perchloride is converted, under these circumstances, into protochloride.

5. A dilute solution of pernitrate of mercury, perfectly free from protoxide, shaken but for a few minutes with charcoal powder, and then filtered, is rendered very turbid by muriatic acid or a solution of chloride of sodium arising from precipitated protochloride of mercury, which proves that the charcoal converts a portion of the pernitrate of mercury immediately into protosalt, even in the cold. By shaking the same solution of pernitrate three or four times, in quick succession, with fresh portions of charcoal powder, I succeeded in obtaining, in the course of a quarter of an hour, a protosalt perfectly free from peroxide. This property of carbon may be usefully employed in freeing soluble protosalts of mercury from any admixture of persalt.—*Poggendorff's Annalen,* lxxviii. p. 521; quoted in the *Mechanics' Magazine*, No. 1419.

NATURAL WATER-PURIFIERS.

Mr. Warrington has for a year past kept twelve gallons of water in a state of admirably balanced purity by the action of two gold fish, six water-snails, and two or three specimens of that elegant aquatic plant known as *Valisperia sporalis.* Before the water-snails were introduced, the decayed leaves of the Valisperia caused a growth of slimy mucus, which made the water turbid, and threatened to destroy both plants and fish. But under the improved arrangement, the slime, as fast as it is engendered, is consumed by the water-snails, which reproduce it in the shape of young snails, whose tender bodies, again, furnish a succulent food to the fish; while the Valisperia plants absorb the carbonic acid exhaled by the respiration of their companions, fixing the carbon in their growing stems and luxuriant blossoms, and refreshing the oxygen (during sunshine, in visible little streams) for the respiration of the snails and the fish. The spectacle of perfect equilibrium thus simply maintained between animal, vegetable, and inorganic activity, is striking and beautiful; and such means may possibly hereafter be made available on a large scale for keeping tanked water clean and sweet.—*Quarterly Review.*

INFLUENCE OF SUNLIGHT UPON THE ACTION OF THE DRY GASES ON ORGANIC COLOURS.

Dr. G. Wilson, F.R.S.E., has reported to the British Associa-

tion the result of a series of experiments made in the summer of 1850, on the effect of daylight in modifying the chemical action of eight different dry gases,—viz. chlorine, sulphurous acid, sulphuretted hydrogen, carbonic acid, a mixture of sulphurous and carbonic acid, oxygen, hydrogen, and nitrogen—on organic colouring matters. All these gases were found to act more powerfully in changing colours when exposed to sunlight than when left in darkness. The effect was greatest in the case of the bleaching gases, especially chlorine, which, the author showed, may be left three years in contact with colouring matter without bleaching occurring, provided moisture is excluded; whereas the same gas, though equally dry, was found to bleach dry colouring matter in six weeks, if exposed to sunshine; so that a fortnight of sunshine is more than equal to a year of darkness in determining the decolorizing action of dry chlorine.

CHEMICAL ACTION OF SOLAR RADIATIONS.

MR. R. HUNT has read to the British Association, an elaborate and interesting communication on the present state of our knowledge of the Chemical Action of Solar Radiations. We may state that it contained a very clear historical sketch of all that had been done in the investigation of the action of light in producing chemical changes, and that it entered at great length into the theory of the Daguerréotype, Calotype, and other Photogenic processes.—*Jameson's Journal*, No. 98.

With respect to the influence of the solar rays upon inorganic bodies, Mr. Hunt thinks it established beyond a doubt—1st. That the maximum of chemical (actinic) phenomena is to be found where there is the least quantity of light and heat. 2. That as the luminous power increases, either in the spectrum or in natural phenomena, the chemical (actinic power) diminishes, until it comes to its minimum, where light—luminous power—exists at its maximum. 3rd, That although the chemical influence extends to the red or heat-giving rays, its operations are materially modified, and to all appearance changed, by the combined operation of the calorific power; and that results standing in direct opposition to those obtained by the pure chemical rays are given by the chemico-calorific rays.

PROGRESS OF PHOTOGRAPHY.

SIR DAVID BREWSTER, the President of the Edinburgh Meeting of the British Association, in August, 1850, in his Inaugural Address, thus called attention to the great improvements or discoveries recently made in Photography:—

"The art of taking photographic *negative* pictures upon paper was the invention of Mr. Fox Talbot, a distinguished member of this Association. The superiority of the Talbotype to the Daguerréotype is well known. In the latter the pictures are reverted, and incapable of being multiplied; while in the Talbotype there is no reversion, and a single negative will supply a thousand copies, so that books may now be illustrated with pictures drawn by the sun.

The difficulty of procuring good paper for the negative is so great, that a better material has eagerly been sought for; and M. Niepce, an accomplished officer in the French service, has successfully substituted for paper a film of albumen, or the white of an egg, spread upon glass. This new process has been brought to such perfection in Edinburgh, by Messrs. Ross and Thomson, that Talbotypes taken by them and lately exhibited by myself to the National Institute of France, and to M. Niepce, were universally regarded as the finest that had yet been executed. Another process, in which gelatine is substituted for albumen, has been invented, and successfully practised by M. Poitevin, a French officer of engineers; and by an ingenious method, which has been minutely described in the weekly proceedings of the Institute of France, M. Edmund Becquerel has succeeded in transferring to a Daguerréotype plate the prismatic spectrum, with all its brilliant colours; and also, though in an inferior degree, the colours of the landscape. These colours, however, are very fugaceous; yet, though no method of fixing them has hitherto been discovered, we cannot doubt that the difficulty will be surmounted, and that we shall yet see all the colours of the natural world transferred by their own rays to surfaces both of silver and paper. But the most important fact in Photography now to mention, is the singular acceleration of the process discovered by M. Niepce, which enables him to take the picture of a landscape illuminated by diffused light, in a single second, or at most in two seconds. By this process, he obtains a picture of the sun on albumen so instantaneously, as to confirm the remarkable discovery previously made by M. Arago, by means of a silver plate, that the rays which proceed from the central parts of the sun's disc have a higher photogenic action than those which issue from its margin. This interesting discovery of M. Arago is one of a series on photometry which that distinguished philosopher is now occupied in publishing. Threatened with a calamity which the civilised world will deplore—the loss of that sight which has detected so many brilliant phenomena and penetrated so deeply into the mysteries of the material world, he is now completing, with the aid of other eyes than his own, those splendid researches which will immortalize his own name and add to the scientific glory of his country."

Full details of M. Poitevin's Experiment are given in the *Comptes Rendus*, No. 21, 27th May, 1850; and in the *Chemist*, July, 1850.

Images of the Sun and Moon obtained on Glass. By M. Niepce De Saint-Victo.—Having lately heard M. Arago state at the Academy that proofs of the Sun had been taken on plates of silver, I wished to see the effect produced on a sheet of glass covered with a layer of coagulated albumen, which, as is known, gives an inverse or negative proof.

I operated in the following manner:—Having prepared my glass plate, without employing any means of acceleration, I exposed it in

the camera-obscura, of which the object glass (I operated with an object glass for a fourth of the plate) was in the direction of the sun, the image of which I had placed in the visual focus, which in this object glass corresponds exactly to the photogenic focus.

My first experiments were made as quickly as possible: that is to say, as quickly as I could uncover and cover the object glass, operating with a diaphragm of five millimetres in diameter. Notwithstanding this, the image came too rapidly. On submitting the plate to the action of gallic acid, it became quite black. I then conceived the idea of raising the diaphragm and leaving the object glass uncovered long enough for the image to appear without the aid of gallic acid; and this succeeded.

The first plate was exposed five, and the second ten, seconds.

These were the results I obtained:—The first plate showed a very visible and distinct image, of a blood-red colour, much deeper in the middle than at the edges, as any one may see by examining the plate.

The second plate presented the same difference between the centre and the circumference, but with greater intensity; besides which, it had a circle beyond the image, in the form of a glory.

The different intensity of the centre and the edge is so much the greater as, notwithstanding the effect of contrast, it is still very perceptible, especially when examined by the microscope And by the same effect of contrast, if the image is blackened with gallic acid, the reverse effect takes place.

I have made more than twenty proofs, and almost always with the same results.

The results of these experiments are quite in conformity with the opinion announced by M. Arago, that the photogenic rays emanating from the centre of the Sun have more action than those near the edge or circumference.

I tried, and with some success, to take the image of the Moon in twenty seconds, the Moon being at the full, and perfectly at the focus of my object glass; and without using a heliostat, I obtained a very round image. But the rapidity with which I operated was so great, that the Moon had not time to move perceptibly; for I should say that if left for 50 seconds, we should have rather an oval image.

To obtain an image of the Moon, I found it necessary to operate in the speediest manner, such as would enable me to take a proof of a landscape illumined by diffused light in one, or at most two, seconds.

I obtained this great rapidity by new means, which I have lately consigned to the Academy in a sealed packet.—*Comptes Rendus*, No. 22, June 3, 1850.

Glass-plates.—Mr. T. A. Malone has communicated to the *Athenæum*, the following process, dated May 2nd: In repeating the experiment of M. Niepce de Saint-Victor on photography on albumen (pub-

lished in the *Technologiste* for 1848), I was led to devise a plan of my making "glass negatives." I proceeded as follows :—To the white of an egg its own bulk of water was added; the mixture beaten into a froth was then put into a strainer made of letter-paper so twisted as to form a cone, having a small aperture at its apex; pinned near the base to hold the paper to its shape. The clear diluted albumen soon passed through into a wide-mouthed bottle, which answered the double purpose of a receptacle for the fluid and a support to the cone. A piece of plate-glass, thick or thin, as you please, was then rubbed with a solution of caustic alkali, washed in water, and dried with a cloth: just before applying the albumen, the glass was breathed upon and rubbed with new blotting-paper; then, to remove dust and fibres, cotton wool was used. Unless this latter and every other precaution is taken to prevent dust, the picture will be full of spots produced by a greater absorption of iodine (in a subsequent process) in those than in the surrounding parts.

Now pour the albumen on the glass, inclining the plate from side to side until it is covered; allow the excess to run off at one of the corners, keeping the plate inclined nearly vertical. As soon as the albumen ceases to drop rapidly, breathe on or warm the lower half of the plate; the warmth and moisture of the breath will soon cause it to part with more of its albumen; wiping the edges constantly hastens the operation.

Until this plan was adopted, the coatings were seldom uniform; the upper half of the plate retained less albumen than the lower,—of course care must be taken to warm only the lower halt. When no more albumen runs down, dry the plate. I use for this purpose a double-ring gas-burner of some eighty jets. A common fire answers as well, save now and then it imparts a little dust.

The film, when dry, is quite free from cracks, and is so thin and transparent that the brilliancy of the glass is unimpaired. It is almost necessary to mark it to know which side has been coated.

The next operation is to iodize the plate. Dilute pure iodine with dry white sand in a mortar, using about equal parts of each. Put this mixture into a square glass trough, and over it place the albumined plate; as soon as the latter has become yellow in colour, resembling beautiful stained glass, remove it into a room lighted only by a candle, or through any yellow translucent substance—yellow calico, for instance. Here plunge it vertically and rapidly into a deep narrow vessel containing a solution of "aceto-nitrate" of silver, made by adding three ounces of nitrate of silver to two ounces of glacial acetic acid, diluted with sixty ounces of distilled water. Allow it to remain until the transparent yellow tint disappears, to be succeeded by a milky-looking film af iodide of silver. Washing with distilled water completes this operation. The plate is now ready for the camera. After it has been submitted to the action of the light, pour over its surface a saturated solution of gallic acid. A negative Talbotype image on albumen is the result. Washing with

water before and after immersion, in a solution of one part of hyposulphite of soda in 16 parts of water, until the yellow tint is removed from the shadows, completes the process.

But where is the novelty? Let us go back a step. While the gallic acid is developing its reddish brown image, pour upon the surface a strong solution of nitrate of silver: the brown image deepens in intensity until it becomes black. Another change commences: the image begins to grow lighter, and, by perfectly natural magic, finishes by converting the black into white, presenting the curious phenomenon of the conversion of a Talbotype *negative* into, apparently, a Daguerréotype *positive*, but by very opposite agency, no mercury being present; metallic silver (probably) here producing the lights, while in the Daguerréotype it produces the shades of the picture. I have said probably, because it may be unwise to speculate chemically upon appearances which may depend solely on molecular arrangement: an intricate subject, to which I hope this communication may prove a slight contribution.

Prof. Wheatstone has suggested to me the desirableness of substituting blackened wood or blackened ivory for glass plates; we should probably then have the novelty of a Daguerréotype on wood free from some of the disadvantages attendant on polish metal. Mr. Cundall suggests the application of it to wood blocks for wood engravers for certain purposes, making the drawings by light instead of by hand.

Albuminizing Photogenic Glasses.—In the *Athenæum*, No. 1205, is a translation by D. Maunoir, of a paper by M. Luigi Ceselli, on a new process for "albuminizing photogenic glasses." It appears to point out a method by which extreme uniformity in the thickness of the film may be obtained. It cannot be denied that Photography has gained much by the substitution of glass for photogenic paper; as thus has been obtained a high degree of transparency of the plates for the process. Many difficulties, however, still existed; for, with the use of glass, a layer of albumen was necessary to the production of those wonderful results obtained by the rays of light. Again, to cover the glass with a layer of albumen of equal thickness, so that the light may produce everywhere the same effect, to prevent any inequalities forming on the surface during the drying process, to produce the layer at one stroke,—such were the difficulties which, notwithstanding repeated experiments, yet remained to be overcome, and had retarded the progress of this wonderful new method; but which, it seemed to M. L. Ceselli, did not deserve to be abandoned, as it had, to be replaced by the improvements obtained with photogenic paper.

After having studied the various processes in use, M. L. Ceselli invented a small simple machine, which he has found to obviate every difficulty. It consists of a small rectangular box, supported by three regulating screws. To its base is joined a moveable plate of metal, which, being heated by means of a lamp of alcohol, communicates to all the parts of the box an equal degree of heat. The

plate is removed when the water-bath is to be used instead of the lamp. The apparatus is protected by a glass covering, to guard against heterogeneous bodies falling on the albumen. This cover is also moveable; and the box being traversed by an internal channel, in this, when convenient, a thermometer may be introduced. A sliding frame receives the glass which is to receive the preparation; this, again, being placed between two other plates of glass. The glasses are secured and their edges brought to correspond by means of a tightening screw, so that the albumen, when either spreading or shrinking, may always cover the whole surface of the intermedial plate of glass. The frame is furnished on two parallel sides with a small groove to receive the albumen, which a small round edged knife, elevated to proper point by means of two spiral pivots cased in the sides of the box, and kept down in a parallel direction to the glass by means of a screw, serves to remove, producing by this means the exact thickness of layer which is required. The frame is furnished along one of its sides with an indented ridge, to which a wheel provided with an external handle corresponds, so that the frame can be made to move with such velocity as the operation may require.

Fluoride of Potassium.—M. Regnault has communicated to the Paris Academy of Sciences, a new photographic process, the discovery of M. Blanquart-Evrard. "The Fluoride of Potassium," says the author, "added to the iodide in the preparation of the negative proof, gives an instantaneous image by exposure in the camera obscura. To assure myself of the extreme sensibility of the fluoride, I have experimented on some of the least sensitive of the photographic preparations, such as plates of albuminized glass simply iodized, requiring an exposure at least sixty times as long as the sensitive paper. By adding the fluoride to the iodized albumen, or by substituting the washing of the plate after the aceto-nitrate with distilled water—by floating over it a solution of the fluoride of potassium, I have obtained instantly an image by exposure in the camera obscura." It must not be forgotten that previous to 1844, Mr. Robert Hunt published a process discovered by him, and called "The Fluorotype." He used both the fluorides of potassium and sodium, and found the latter salt, combined with bromide of potassium, the most useful. Papers prepared according to a formula given in that gentleman's "Researches on Light" are stated by him "to keep for some weeks without injury, and they become impressed with good images in half a minute in the camera."

Mr. Fox Talbot has completed the specification of his new patent for improvements in Photography. Its only novelty is the use of plates of porcelain instead of glass.—*Athenæum*, No. 1185.

Crayons Daguerréotypes.—Mr. Mayall, of the West Strand, has communicated to the *Athenæum*, No. 1197, the following process:—

1st. Take a Daguerréotype image on a prepared plate as usual, taking care to mark the end of the plate on which the head is produced. When taken, and before mercurializing, remove the plate

from the holder, and place on it a plate of glass prepared as follows. 2nd. Cut a piece of thin plate-glass of the same size as the Daguerréotype plate, gum upon one side of it a thin oval piece of blackened zinc, the centre of the oval to coincide with the centre of the image upon the plate. Having carefully placed the glass thus prepared with the centre of the zinc disc upon the centre of the image, expose the whole to daylight for 20 seconds. The action of the light will obliterate every trace of image from every part of the plate, except that which is covered with the blackened zinc; and also from the thickness of the glass the action will be refracted under the edges of the zinc disc, and will soften into the dark parts. Mercurialize the plate as usual; the image will be found with a halo of light around it, gradually softening into the background, that will at once add a new charm to these interesting productions. By grinding the glass on which the disc is fixed, and by altering the shape and size of the disc, a variety of effects may be produced which every ingenious operator can suggest for himself.

Accelerating Process. By J. Middleton, F.G.S.—The following method of preparing sensitive paper may, perhaps, be welcome to photographers on account of the great sensibility which it confers; it has the additional recommendation, moreover, of being very simple and constant in its results.

I beat up albumen of the egg of the duck till it becomes liquid, and then mix it with water in the proportion of eighty grains of the former to an ounce of the latter. I add to this solution iodide of potassium in the proportion of twenty-five grains to the ounce. Prior to the application of this solution I wash the size from the side to be rendered sensitive, by means of a camel-hair brush; when dry, I float the paper on the solution, for from three to four minutes, and when drained and dried I lay it aside for use.

When about to be used for taking a picture, the paper, prepared as above directed, is to be washed with aceto-nitrate of silver, in the proportion of sixty grains of nitrate and eighty grains of acetic acid to an ounce of water (Talbot's strength). I apply the solution with a glass rod, in the manner recommended some time since by a writer in the *Philosophical Magazine*, using about forty grains of it to a quarto page, and allow the paper to dry in the dark; it is now ready for the camera. While applying the sensitive coat, as also while bringing out the picture, I take the precaution to use a yellow light. I find that from ten to fifteen seconds is, with ordinary sun-light, sufficient exposure, the latter being generally too great.

When the picture has been taken, no trace of it appears on the paper, but it comes speedily out on the application of a saturated solution of gallic acid. I turn up the edges of my paper and pour the solution on till the paper is entirely covered; and keep it so till the picture has come sufficiently out, when I fix it in the usual way.

I find that if bromide of potassium be substituted for iodide of potassium, in the first process, a picture is obtained; but the time of exposure required is then about a minute. Again, bromide or chloride of potassium does not serve to accelerate, as in the ordinary processes, but the contrary; gallic acid too, added to the aceto-nitrate, destroys sensitiveness. I find also, that if the albumen be dried, and afterwards dissolved up and used as above described, it has lost its photographic value; a circumstance which would seem to indicate that photographic properties are connected with, or dependent upon, molecular arrangement.

The employment of albumen in photography is not, I believe, new: it has not, however, so far as I am aware, been used in the way or with the effect stated above.—*Communicated to the Philosophical Magazine*, No. 249.

ADDENDUM TO THE PROPERTIES OF PEAT CHARCOAL, AT PAGE 202.

In November last appeared in the *Times* the following statement:—

It now appears that Mr. Owen, whose course from the first was in no way inconsistent with Lord Ashley's testimony respecting him, has been for the past year and a half quietly engaged in testing the merits of the process to an extent that would properly authorise a definitive estimate of its results. These labours have been carried on partly under the superintendence of Dr. Hodges, the Professor of Agriculture in Queen's College, Belfast; and partly in the neighbourhood of London, at the premises of Messrs. Coffey and Sons, the engineers: and the conclusions now represented to have been arrived at are of an exceedingly satisfactory nature. They do not promise the 500 per cent. originally talked of; but, according to a certified estimate rendered by Messrs. Coffey, they show a profit of upwards of 100 per cent. This estimate, which is framed for an establishment consuming 36,500 tons of peat per annum, is as follows:—

EXPENDITURE.

36,500 tons of peat at 2s. per ton	£3,650
455 tons of sulphuric acid at £7	3,185
Wear and tear of apparatus, &c.	700
Wages, labour, &c.	2,000
Cost of sending to market, and other incidental charges	2,182
Profit	11,908
	£23,625

PRODUCE.

365 tons of sulphate of ammonia at £12 per ton	£4,380
255 tons of acetate of lime at £14	3,570
19,000 gallons of naphtha at 5s.	4,750
109,500 pounds of paraffine at 1s.	5,475
73,000 gallons of volatile oil at 1s.	3,650
36,000 gallons of fixed oil at 1s.	1,800
	£23,625

This (says the *Athenæum*, No. 1205) is but a repetition of the original statement: and we at once detect in the estimate many fallacious particulars,—unless the experience of Sir Robert Kane, as given in his "Industrial Resources of Ireland," be valueless. We have, besides, the experiments made by the Dartmoor Company, on a large scale, at the loss of many thousand pounds, giving their admonitory lesson, in reply to this very loose estimate made by Messrs. Coffey. We wish these results may be realized, but we have no hope of anything so satisfactory.

Natural History.

ZOOLOGY.

THE ZOOLOGICAL SOCIETY OF LONDON.

THE Report of the Council read to the Anniversary Meeting, in May last, stated, that the fellows, fellows-elect, and annual subscribers at that time amounted to 1,665. The number of honorary and foreign members was 29; and of corresponding members, 155. Among the corresponding members, the Society had to regret the loss of Sir T. Reade, Her Majesty's Consul-General at Tunis, who for many years was a liberal contributor to the Society, presenting them with many of the most valuable carnivora and struthious birds. The revenue of the Society amounted in 1849 to £8,771. 9*s.* 8*d.*, being an increase of £606. 8*s.* 5*d.* as compared with 1848, and of £1,005. 14*s.* 2*d.* as compared with 1847. The Council regarded this result as conclusive evidence in favour of the measures commenced in 1848 for developing the resources of the Society, for improving the menagerie, and for the extension of the facilities for visiting it. The increase in the receipts at the gates in 1849, of £1,124. 19*s.* 6*d.*, as compared with 1847, justified the hope that this source of revenue would gradually resume the importance which it presented in the earlier period of the operations of the Society. The actual increase in the number of visitors in 1849, as compared with 1848, was 25,265; and it was scarcely to be doubted that it would have been still larger but for the epidemic which prevailed in August and September. The report from the gates of the current year presented an increase in the receipts of £130, as compared with the corresponding weeks of 1849, and of £259. 10*s.* 6*d.* as compared with 1848. The Council considered that the decrease of subscriptions had been checked as compared with the ratio of preceding years; and the decrease which for many years existed at the garden gates up to 1847 was not only determined, but the receipts were rapidly rising, and exhibited such a tendency to advance as more than counterbalances the decrease on the other heads of income.

The recent liberal expenditure in buildings and the purchase of animals had not only been rewarded by the re-establishment of the celebrity of the collection, as the finest public vivarium in Europe; but had enabled the Council to create a considerable source of income in the disposal of duplicates—the most desirable specimens being invariably preserved for the menagerie. The memorial to the Commissioners of Woods and Forests had met with attention, and the rent of the gardens is reduced to £337, whereby a saving of £167 per annum is effected. The comparison of expenditure with income is, however, still unfavourable, if the outlay on new buildings was not considered rather as a change of investment than expenditure—that expenditure having brought the establishment to a state of efficiency and attractiveness which the Council believe will

obviate for a considerable time the necessity of further building operations beyond the works now in progress. The buildings completed during 1849 were of the most important kind for the preservation of the collection, and in their advantages far exceeding the value of the annual dividend hitherto received on the capital employed. The ordinary expenditure of the Society might be taken at about £8,500; and there is, therefore, every probability that the increasing income of the Society will produce a surplus sufficient for all the purposes of a reserve.

During the past year the additions to the Museum of mounted specimens had been limited to such rare species as had died in the Menagerie, and were not previously represented in the Museum. Many duplicates had been presented to provincial institutions at Norwich, Ipswich, Dover, Worcester, &c.; and some valuable presents had been received from different individuals. Although no important additions have been made to the library by purchase, several desirable and valuable works have been added by donations; and by exchange for the publications of the Society from a variety of scientific institutions at Paris, Munich, Breslau, Göttingen, Philadelphia, Berlin, Stockholm, Van Diemen's Land; many distinguished scientific bodies in England, Ireland, and Scotland, &c., as well as from authors. The principal buildings executed during the past year have been a continuation of the new aviary, the house for reptiles, a large inclosure for grallatorial birds, the erection of a wing at the west end, and the commencement of one at the east end of the giraffe house, and the putting into repair other buildings connected with the Gardens. In the Gardener's department, the Council had received various donations from the Horticultural Society, his Grace the Archbishop of Dublin, and other friends; and constant attention had been paid to keeping it in order.

With regard to the Menagerie, the Council had made great progress, and had been fortunate in obtaining the support of many additional correspondents. The collections of valuable animals presented by the late Pasha of Egypt, and by the Governor of Singapore, having been safely brought to this country about the same time, the Menagerie might be considered as having reached the highest point of value in July, 1849; and it was worthy of remark that the number of visitors in that month far exceeded the average number of the last ten years. The Council had the satisfaction of announcing that H.H. Abbas Pasha had presented to the Society a Hippopotamus, which he had consigned to the care of the Hon. C. A. Murray, who, in a recent dispatch, had described him as in good health, and as "tame and playful as a Newfoundland puppy." Her Majesty had presented to the Society the principal portion of a present received from the Emperor of Morocco, consisting of a lioness, leopard, two ostriches, and two gazelles. During the past year the female aurochs and three bisons were carried off by pleuropneumonia, the scourge of horned cattle. The rhinoceros and African

buffalo had also died; but, as the former had been upwards of fifteen years in the Menagerie, and the latter nearly as long, their longevity, rather than their decease, was to be remarked on. The health of the collection generally is attested by the beautiful condition and by the numerous list of species which have been bred in the Gardens. The Council have great pleasure in announcing that, notwithstanding the long list published in 1848 and 1849, the Society had been able to obtain upwards of seventy new species, exhibited for the first time during the past year. The total number of visitors to the Gardens in 1849 was 168,895: of these 33,998 were privileged, and 134,897 unprivileged, of whom upwards of 72,000 were admitted on Mondays.

MORPHOLOGY OF THE MUSCULAR SYSTEM.

Mr. Zaglas has given to the British Association, an exposition of his views of the Morphology of the Muscular System. He showed that by tracing the development of the muscles, from the fishes up to the higher mammalia, there were certain general laws which governed their form and relationship one to another. Prof. A. Thomson remarked on the novelty of the author's views. He saw no occasion why we should not have the same general laws applying to the muscular system as we found prevailing with regard to the nervous and osseous systems.

ON EXUVIATION, OR THE CHANGES OF INTEGUMENTS BY ANIMALS.

Sir J. G. Dalyell has read to the British Association, a paper on this subject. The observations of the writer were confined to the family of Crustacea. He described minutely the changes undergone by crabs during the process of moulting, and, in several instances, counted the number of days from one moult to another. These varied from 60 to 194 days. In all cases he found that no reparation of wounded, mutilated, or destroyed parts took place till after the moult which succeeded the injury. He described minutely several cases in which injuries of various kinds had been repaired. In one case of the moult of a crab, only the two claws of the dermal skeleton were developed, whilst the eight legs were entirely suppressed. At the next moult, the animal produced its usual number of legs.

Professor Owen wished to express the obligations under which naturalists were to Sir J. Dalyell for his numerous observations in natural history. The subject of the present paper was one of great interest, and demanded further investigation. Professor Van der Hoeven stated that the remarks of Sir John confirmed those of Mr. Newport on the change of skin and the reproduction of lost members in the family of spiders. Mr. Peach said that the white colour of the young crabs mentioned by Sir John was owing to confinement. He believed from his own observations that limbs were only reproduced after exuviation. Amongst the Crustacea which he had ob-

served, the hermit crabs shed their skin most frequently: sometimes as often as five or six times in a month.

CIRCULATION AND DIGESTION OF THE LOWER ANIMALS.

Prof. Agassiz states, that the Circulation of the Invertebrata cannot be compared to that of the Vertebrata. Instead of the three conditions of chyme, chyle, and blood, which the circulating fluid of the vertebrata undergoes, the blood of that class of the invertebrata which he had particularly studied, the annelida or worms, is simply coloured chyle. The receptacles of chyle in different parts of the body are true lymphatic hearts, like those found in the vertebrata; this kind of circulation is found in the articulata and molluscs, with few exceptions, and in some of the echinoderms. In the medusæ and polyps, instead of chyle, chyme mixed with water is circulated: this circulation is found in some molluscs and intestinal worms. Professor Agassiz thinks that the embryological development of the higher animals shows a similar succession in the circulating function. As regards the connection between respiration and circulation in vertebrata, the gills are found between branches of the blood system; in invertebrata, the chyliferous system is acted on by the respiration. The gills of fishes, therefore, cannot be compared to the gills of crustacea, articulata, and molluscs. In fact, no gills are connected with the chymiferous circulation. Animals having this circulation, have no true respiration. They have only tubes to distribute freshly aërated water to different parts of the body.—*Proc. Bost. Nat. Hist. Soc.*

NOTES ON CRUSTACEA. BY DR. T. WILLIAMS.

These Notes are, first, on the Development of the Shell. Under this head, the author gives an account of the changes observed in the shell during its growth when examined by the microscope. In the first place, a production of cells was observed over the region of the heart. This gradually spread and formed the upper layer of the dermal skeleton. Under this was formed a layer of pigment cells, and below this again layers of smaller cells, till the whole integument was formed. The younger the animal, the oftener this process went on; till at last it went on very slowly, or ceased altogether. Secondly, the shedding of the exuviæ. This process seemed in a great measure under the control of the animal; as, when watched, it frequently suspended this operation, or when excited, hastened it. It appears to be attended with excitement of the nervous system, as at this period the animal was more pugnacious than at any other. Thirdly, the reproduction of limbs. This process only took place after the exuviation of the old skin, although a reparative process was evidently set up in the injured part. At the moult immediately subsequent to the loss of a limb, the new limb was not so large as those which represented uninjured limbs.—*Proceedings of the British Association*, 1850.

REPRODUCTION OF LIMBS AFTER AMPUTATION IN THE HUMAN SUBJECT.

Dr. Simpson, in a paper read to the British Association, has shown that the power of reproducing and repairing lost parts is greatest in the lowest class of animals, and decreases as we ascend higher and higher in the scale of animal life. He then points out that the embryo approaches in this, as in other respects, the physiological life and powers of the lower animals; and, consequently, when the arm or leg is amputated during embryonic existence, as not unfrequently happens from bands of coagulable lymph, and the results of disease, the stump structures reproduce a small rudimentary hand or foot, as the crab or lizard does. He showed various casts and drawings of cases of hands thus reproduced; and two living examples were exhibited.

LOW STATE OF DEVELOPMENT OF MAMMALS AND BIRDS IN AUSTRALIA AND NEW ZEALAND.

Geological researches into the structure of the globe show that a succession of physical changes have modified its surface from the earliest period up to the present time; and that these changes have been accompanied with variations, not only in the phases of animal and vegetable life, but often in the development also of organization; and as these changes cannot be supposed to have been operating uniformly over the entire surface of the globe in the same periods of time, we should naturally be prepared for finding the now existing Fauna of some regions exhibiting a higher state of development than that of others: accordingly, if we contrast the Fauna of the old continents of geographers with the zoology of Australia and New Zealand, we find a wide difference in the degree of organization which creation has reached in these respective regions. In New Zealand, with the exception of a *Vespertilio* and a *Mus*, which latter is said to exist there, but which has not yet been sent to this country, the most highly organized animal hitherto discovered, either fossil or recent, is a bird: in Australia, if compared with New Zealand, creation appears to have considerably advanced, but even here the order *Rodentia* is the highest in the scale of its indigenous animal productions; the great majority of its quadrupeds being the Marsupiata (kangaroos, &c.) and the *Monotremata* (*Echidna* and *Ornithorynchus*), which are the very lowest of the Mammalia; and its ornithology being characterised by the presence of certain peculiar genera, *Talegalla*, *Leipoa*, and *Megapodius*,—birds which do not incubate their own eggs, and which are perhaps the lowest representations of their class; while the low organization of its botany is indicated by the remarkable absence of its fruit-bearing trees, the *Cerealia*, &c.—*Gould's Birds of Australia.*

Mr. Gould gives the following summary of the distribution of the birds of Australia:—385 species inhabit New South Wales, 289 South Australia, 243 Western Australia, 230 Northern Australia, and 181 Van Diemen's Land; and that of these, 88 are peculiar to

New South Wales; 16 to South Australia; 36 to Western Australia; 105 to Northern Australia; and 32 to Van Diemen's Land.

The great excess in the number of species inhabiting New South Wales is doubtless attributable to the singular belt of luxuriant vegetation, termed brushes, which stretches along the southern and south-eastern coasts, between the ranges and the sea, and which is tenanted by a Fauna peculiarly its own.

Although this part of the continent is inhabited by a larger number of species than any other, it is a remarkable fact that the species peculiar to Northern Australia are much more numerous than those peculiar to New South Wales.

COMMUNICATION BETWEEN THE TYMPANUM AND PALATE IN THE CROCODILIAN REPTILES.

PROF. OWEN has communicated to the Royal Society, a paper on this subject. After citing the descriptions by Cuvier, Kaup, Bronn, and De Blainville, of the Eustachian tubes and the foramina in the base of the cranium of the recent and extinct Crocodiles, the author gives an account of nerves, arteries, veins, and air-tubes that traverse these different foramina, and thus determines the true position of the carotid foramina and posterior nostrils in the *Teleosauri* and other fossil *Crocodilia*, which had been a matter of controversy amongst the authors cited. In the course of these researches, the author discovered a distinct system of Eustachian canals superadded to the ordinary lateral Eustachian tubes, which he describes as follows:—

"From each tympanic cavity two passages are continued downwards: one expands and unites with its fellow from the opposite side to form a median canal which passes from the basisphenoid to the suture between that and the basioccipital, where it terminates in the median canal continued to the orifice described by M. De Blainville as the posterior nostril;—the second passage leads from the floor of the tympanic cavity to a short canal which bends towards its fellow, expands into a sinus, and divides: one branch descends and terminates in the small lateral foramen at the lower end of the suture between the basioccipital and the basisphenoid; the other branch continues the course inwards and downwards until it meets its fellow at the median line of the basioccipital, and it forms the posterior primary division of the common median canal: this soon joins the anterior division, and the common canal terminates at the median opening below. Membranous tubes are continued from the three osseous ones, and converge to terminate finally in the single Eustachian orifice on the soft palate behind the posterior nostril. The mucous membrane of the palate lines the various osseous canals above described, and is continued by them into the lining membrane of the tympanum.

With regard to the homologies of the above-described air-passages, the author states that the lateral canals answer to the simple Eustachian tubes of Lizards and Mammals; and that the median canal,

with its dichotomous divisions, is a speciality peculiar to the crocodilian reptiles.

DISTRIBUTION OF MARINE ANIMALS.

PROF. E. FORBES has presented to the British Association, a Report containing a vast body of accurate observations and carefully stated facts "On the Infra-littoral Distribution of Marine Animals on the Southern, Northern, and Western Shores of Scotland;" in part the result of a Committee of the British Association formed in the year 1839 for the purpose of investigating the natural history of the British seas by means of the dredge, which has been used within the area reported on in all depths between four and a hundred fathoms. Everywhere do we find the distinction of Littoral, Laminarian, and Coralline zones maintained, and in the Scottish provinces, that deeper region to which Prof. E. Forbes had previously given the name of "deep-sea coral," on account of the numbers and abundance of calcareous, zoophytic, and bryozoic polypedons procured from the greater depths. Between the coasts of Cornwall and Ireland Mr. Mac Andrew has dredged and carefully noted the Mollusca inhabiting the region of fifty fathoms; and it is very curious and interesting to observe that only at such depths, and in peculiar localities, in the southern part of the British Seas, do we find those species of Scandinavian origin which give a feature to even the shallower zones in the sea-beds of North Britain. The tables now presented show that whilst certain species of marine creatures are absolutely restricted to defined provinces of depth, those of the Littoral and Laminarian zones, being especially limited in range, alter; and not a few have a power of enduring all the various conditions between the coast line and 100 fathoms, but in every case of wide range there is some portion in each region where the individuals of each species attain a maximum in number. The higher zones of our sea are distinguished by the presence of peculiar genera as well as species; but in the lower zones the peculiarity is maintained almost entirely by peculiar species of genera, which have a wide bathymetrical range. According to the nature of the sea-bottom, the proportion of species and of individuals of particular tribes of Mollusca and Radiata is determined. Among the former, the Acephalous species prevail over the Paracephalous, in proportion to the more sandy or muddy character of the soundings; whilst the latter equal or exceed the former when the bottom is of mullipore, or hard, or abounding in stones of any size. A comparison of the species of Mollusca and Radiata, in the several provinces before enumerated, shows beyond question that there is a distinct distribution of them horizontally; and that the elements of our marine Fauna are derived from opposite directions, mingled, however, with a general assemblage, of which the British Seas may be regarded as the centre. To the influence of the Rennell's current we may attribute much of the southern element in our marine Fauna; to that of currents setting in from the north, the Scandinavian and arctic elements. But

when all the cases of distribution clearly to be attributed to such influences are enumerated, there remains a residue which we can only explain by going back to epochs anterior to our own, and to a different conformation of the coast of Europe, and a different set of currents from those which now prevail.—*Athenæum*, No. 1190.

OPERATIONS FOR CATARACT ON BEARS.

Two of the three fine young grizzly Bears recently added to the menagerie of the Zoological Society having become blind, and their value thereby greatly diminished, Mr. Mitchell, Secretary to the Society, proposed to Mr. White Cooper, F.R.C.S., to make an effort to restore them to sight; and Dr. Snow having kindly undertaken the application of chloroform for this purpose, the first operation was performed on the 5th of last November.

The patient having been separated from the other bears, a strong leathern collar and chain was buckled round his neck, and the chain being passed round one of the front bars of the cage, two strong men proceeded to pull him to it as a bullock is hauled to the slaughtering ring. The bear was the size of a young donkey, and his resistance was quite remarkable: for full ten minutes he set their efforts at defiance, and ultimately it was only by the united strength of four men that he was placed in a position favourable for the application of the chloroform. Dr. Snow endeavoured to hold a sponge to his nose, but it was only by fairly tying it to his muzzle that the object was attained. The dropping of the paws, with the cessation of his roaring and struggles, told that he was insensible; and, the sponge being removed, he was laid with his head on a plank outside the den. A solution of atropine had been placed in the eyes on the previous evening, and the pupils were found fully dilated. The instrument used was a strong straight cutting needle. The extraordinary toughness and thickness of the cornea rendered the insertion of this difficult; and the lens was singularly large in proportion to the eye. This rendered the breaking up of that body by no means easy, and it occupied full a minute. The morning was dark, and the margin of the deep brown iris not distinctly seen, which led to its being wounded in one eye and bleeding freely. The cataracts having been thoroughly destroyed, the bear was drawn again into the den. For some minutes he continued in a state of profound coma, giving scarcely any evidence of life; but gradually recovered, and, rising with some difficulty, he staggered into his sleeping apartment.

On the following morning, the door of the dormitory was thrown open, and the bear came out with his eyes open, faced the light without the slightest inconvenience, and began licking his paws with perfect satisfaction. A dose of Rochelle salts was given to him rather as a matter of precaution than because it was needed, and his recovery was rapid, not one red vessel discolouring the conjunctiva at any time.

Encouraged by this result, a similar operation was performed on the second bear on November 15th. This animal was brought out

of the den and secured to the iron rail in front by six men, and was thus more manageable. The dose administered on the first occasion being rather greater than was needed, Dr. Snow this time used chloroform and spirit in equal proportions. The bear not being perfectly insensible when the operation was commenced, there was some difficulty with the left eye; for, at each attempt to insert the needle, the cornea turned in beneath the membrana nictitans and was quite invisible. At length, by plunging the instrument perpendicularly to the surface, the very tough cornea was penetrated, and the cataract broken up. To obviate such a movement in the right eye, the needle was introduced at the inner and lower margin of the cornea, and the operation easily completed. The recovery of this animal was quite as rapid as that of the former one.

CAPTURE OF A SEA-COW.

Messrs. Clark and Burnham lately succeeded in capturing a Sea-Cow, near Jupiter Inlet, Florida. The animal was caught in a net, was a male, and nine feet three inches in length. They succeeded in taking it alive, and shipped it to Charleston for exhibiting it. It was very wild when first captured, but soon became quite tame, and eat freely of grass, &c. Its tail is in the shape of a fan, and is 2 feet 5 inches broad. It has no hind feet; its fore feet are similar to those of a turtle, and it has nails like those of the human hand, but no claws. Its mouth and nose resemble those of a cow; it has teeth on the lower jaw, but none on the upper. A female was also taken, but it was so large, and becoming entangled in the net made such desperate exertions to escape, that the captors were compelled to shoot it. They preserved the skin, however, which is 15 feet long. This is the second instance (says the *Havannah News*) within our knowledge that the sea-cow has been captured. Some years ago, during the Florida war, Colonel Harney shot two of them in the Everglades. He preserved the hides, and they were exhibited in St. Augustine as a great curiosity. We saw a rib of one of the animals yesterday in possession of a gentleman of this city, to whom it was presented by Colonel Harney. He informed us that he had partaken of the flesh, and pronounced it remarkably tender and palatable, and far superior to beef.

MANDRILL BABOON.

A fine specimen has been added to the Zoological Society's Menagerie in the Regent's Park. It was received from Mr. George Brand, Her Majesty's consul in the province of Angola, in South-western Africa, and was disposed of to the Zoological Society by Mr. Edmund Gabriel, Her Majesty's arbitrator in that province. This Mandrill is between three and four years old, and measures about 5 feet, when standing upright.

WART-HOG.

Professor Owen has communicated to the Royal Society, a paper "On the Development and Homologies of the Molar Teeth of the

Wart-Hog (Phacochærus), with illustrations of a system of notation for the Teeth in the class Mammalia." The author proves that, contrary to the opinion of Home and Cuvier, the Wart-hogs have deciduous teeth, succeeded vertically by premolar teeth: in the *Phacochærus Æliani*, at least, three deciduous teeth are, in some individuals, succeeded by as many premolar teeth; and, as a general rule, two deciduous teeth are displaced vertically by two premolars. The first true molar is remarkable for its unusually early development, which is followed by an unusually early abrasion and expulsion, when its place is obliterated by the second true molar being pushed forwards into contact with the last premolar. This tooth is as remarkable for its longevity, and remains after the wearing away and shedding of the second true molar, when the last true molar advances into contact with the last premolar; and the place of both the previously intervening true molars is obliterated. This unusual order of shedding of the molar teeth has given rise to the idea of the last large and complex true molar of the *Phacochærus* being the homologue of both the last and penultimate grinders of the common hog, which the author's observations refute; and he also is able to point out, by re-examination of the original specimen figured by Home in the *Phil. Trans.*, the source of the erroneous idea that the common hog had an additional true molar behind the large one symbolised by *m* 3, in the author's system of dental notation. The nature and signification of the symbols proposed are explained and illustrated by a series of drawings. One of the fruits of the determination of the homology of a part is the power of giving it a name, and signifying it by a symbol applicable co-extensively with such homology.

HIPPOPOTAMUS IN THE MENAGERIE OF THE ZOOLOGICAL SOCIETY.

For several years past, the Zoological Society have been anxious to obtain a living specimen of this great amphibious quadruped for their Menagerie. Several attempts with this object have been made within the last twenty years, but uniformly with ill success; and the offer of an American agent at Alexandria to give £5,000 for an animal of this species, delivered to him at the above city, entirely failed to induce any speculator to encounter the risk and labour of an expedition to the White Nile, above Cairo, where the animal is often shot with rifle-balls, but is very rarely taken alive. At length, the Society's wish was made known to Abbas, Viceroy of Egypt, who gave the requisite commands, and the proper parties were sent in search of the animal.

This was in August, 1849, when the hunters having reached the island of Fobaysch, on the White Nile, about 2,000 miles above Cairo, shot a large female Hippopotamus in full chase up the river. The wounded creature turned aside, and made towards some bushes on the island bank, but sank dead in the effort. The hunters, however, kept on towards the bushes, when a young male Hippopotamus, supposed to have been recently brought forth, being not much bigger than a new-born calf, but much stouter and lower, made a

rush down the bank to the river; he had nearly escaped, owing to the slipperiness of his naked skin, and was only secured by one of the men striking the boathook into his flank, while another lifted him into the boat.

The wound was dressed, and the captured Hippopotamus was conveyed down the Nile, fed entirely on milk, to Cairo, which he reached on Nov. 14, 1849. The colour of his skin at this time was a dull reddish brown. Here he wintered; and in the spring preparations were made for shipping him at Alexandria, in the *Ripon* steamer. On the main deck was built a house, from which were steps, down into an iron tank in the hold: this contained 400 gallons, and was filled with fresh water every other day; for which purpose, in addition to the supplies from time to time to be taken on board, was to be used the condensed water of the ship's steam-engines, which amounted to 300 gallons per day.

Early in May, the Hippopotamus left Cairo, and was conveyed in the canal-boat, with Hamet Safi Canuana, his nurse and attendant, to Alexandria. Thence he was conveyed on board the *Ripon* steamer, which also took to the Zoological Society a collection of quadrupeds and birds, among which were an ibex from Mount Sinai, a lion, a leopard, two lynxes, an ichneumon, some civet cats, and a variety of serpents, lizards, and desert rats. A young giraffe was also to have formed part of the collection, but it was unfortunately drowned in the canal after reaching Alexandria.

The Hippopotamus bore the voyage so well as to increase in fatness; he lived exclusively on milk, of which he consumed daily about forty pints, yielded by several cows on board. He was very tame, allowed himself to be freely handled by his Arab attendant, Hamet, whom he followed like a faithful dog, and who was seldom away for more than five minutes without a summons to return in the sound of a loud grunt. Hamet slept in a berth with the Hippopotamus, strange bedfellow as he was; and thus they arrived in the *Ripon* at Southampton, on Saturday, May 25. He was landed early in the morning, sent by special train by the South Western Railway to London, and was safely housed at ten o'clock at night in the comfortable quarters prepared for him in the Regent's Park.

Among the earliest visitors was Professor Owen, who has communicated his first impressions from a survey of the animal, in a letter to the Editor of the *Annals of Natural History* for June.

"When I saw the Hippopotamus the next morning," says Professor Owen, "it was lying on its side in the straw, with its head resting against the chair in which its swarthy attendant sat. It now and then uttered a soft complacent grunt, and lazily opening its thick, smooth eyelids, leered at its keeper with a singular protruding movement of the eyeball from the prominent socket, showing an unusual proportion of the white, over which large conjunctival vessels converged to the margin of the cornea. The retraction of the eyeball is accompanied by a protrusion of a large and thick *palpebra nictitans*, and by a simultaneous rolling of the ball obliquely downwards, or inwards, or forwards.

"The young animal, which we may reckon to be 10 months old, is now (May 26) 7 feet long, and 6½ feet in girth, at the middle of the barrel-shaped

trunk, which is supported, clear of the ground, on very short and thick legs, each terminated by 4 spreading hoofs: the innermost is the smallest in the fore feet; the two middle ones, answering to those which are principally developed in the hog, are the largest in both feet. The hind limb is buried in the skin of the flank nearly in the prominence of the heel. Thick flakes of the cuticle are in process of detachment from the sole. There is a well defined white patch behind each foot, but I looked in vain for any indications of the glandular orifice which exists in the same part of the rhinoceros. The naked hide covering the broad back and sides is of a dark India-rnbber colour, impressed by numerous fine wrinkles, crossing each other, but disposed almost transversely.

"When I first saw the beast, it had just left its bath, and a minute drop of a glistening secretion was exuding from each of the conspicuous muco-sebaceous pores which are dispersed over the whole integument, at intervals of from 8 lines to an inch. This gave the hide, as it glistened in the sunshine, a very peculiar aspect. When the animal was younger, the secretion had a reddish colour, and being poured out more abundantly, the whole surface became painted over with it every time he quitted his bath. The integument is impressed by a groove, which passes transversely from shoulder to shoulder, and there are two transverse nuchal folds, crossed by a medial longitudinal furrow, the lateral moieties of the strong *ligamentum nuchæ* forming a pair of well marked prominences behind the occiput.

"The ears are very short, conical, fringed with short scattered hairs along the lower half of their thick borders, and beset with a few clumps of short hairs upon the middle of their inner surface. It moves them about with much vivacity. The dark colour of the body extends forwards along the middle of the upper part of the head, and more faintly along the cheeks. The skin around the ears is of a light reddish brown colour and almost flesh-coloured round the eyelids, which defend the peculiarly situated and prominent eyes. There is a single groove or fold above the upper eyelid, and two curved grooves below the lower one. At first sight they seem to be devoid of eyelashes, but on a close inspection a few very short hairs may be seen on the thick rounded margin of the upper lid. There is a carbuncle or protuberance on the middle of the outer surface of the nictitating lid. The colour of the iris is a dark brown; the pupil is a small transversely oblong aperture. The eyeball is relatively small, and is remarkable for the extent of the movements of protraction and retraction. The nostrils, situated on prominences, which the animal has the power of raising on the upper part of the broad and massive muzzle, are short oblique slits, guarded by two valves, which can be opened and closed spontaneously, like the eyelids. The movements of these apertures are most conspicuous when the beast is in his favourite element.

"The wide mouth is chiefly remarkable for the upward curve of its angles towards the eyes, which gives a quaintly comic expression to the massive countenance. The short and small milk tusks project a little, and the minute deciduous incisors appear to be sunk in grooves or pits of the thick gums; but the animal would not permit any close examination of the teeth, withdrawing his head from the attempt, and then threatening to bite. The muzzle is beset with short bristles, projecting at pretty regular distances, several of them appearing to be split into tufts or pencils of short hairs. Extremely fine and short hairs are scattered all over the back and sides, which are not very obvious, except upon a close inspection. The tail is short, rather flattened, and generally tapering to an obtuse point."

Professor Owen continues:—"After lying abruptly about an hour, now and then raising its head and swivelling its eyeballs towards the keeper, or playfully opening its huge mouth, and threatening to bite the leg of the chair on which the keeper sat, the Hippopotamus rose, and walked very slowly about its room, and then uttered a loud and short harsh snort four or five times in quick succession, reminding one of the snort of a horse, and ending with an explosive sound like a bark. The keeper understood the language, and told us that the animal was expressing its desire to return to its bath.

"The beast, at this time, was in one of the compartments of the wing of the giraffe-house, on the opposite side to that in which its bath is prepared. It carries its head rather depressed, and reminded us of a hugh prize hog, but with a breadth of muzzle and other features peculiarly its own. The

keeper opened the door leading into the giraffe's paddock, and walked round that to the new wing containing the bath, the hippopotamus following like a dog, close to his heels. On arriving at the bath-room, the animal descended with some deliberation the flight of low steps leading into the water, stooped and drank a little, dipped his head under, and then plunged forwards. It was no sooner in its favourite element than its whole aspect changed, and it seemed inspired with new life and activity; sinking down to the bottom, and moving about submerged for a while, it would suddenly rise with a bound, almost bodily out of the water; splashing back, it commenced swimming and plunging about with a cetaceous, or porpoise-like rolling from side to side, taking in mouthfuls of water, and spirting them out again, raising every now and then its huge grotesque head, and biting the woodwork of the margin of the bath. The broad rounded back of the Hippopotamus being now chiefly in view, it looked a much larger animal than when out of the water.

"After half an hour spent in this amusement, it quitted the water at the call of its keeper, and followed him back to the sleeping-room, which is well bedded with straw, and where a stuffed sack is provided for its pillow, of which the animal, having a very short neck, thicker than the head, duly avails itself when it sleeps. When awake, it is very impatient of any absence of its favourite attendant, rises on its hind legs, and threatens to break down the wooden fence, by butting and pushing against it in a way strongly significative of its great muscular force. The animal appears to be in perfect health, and breathes, when at rest, slowly and regularly, from three to four times in a minute. Its food is now a kind of porridge, of milk and maizemeal. Its appetite has been in no respect diminished by the confinement and inconveniences of the sea-voyage, or by change of climate. It is more than half-weaned from the milk-diet, which, it is said, created a scarcity of that article at Cairo, owing to the enormous supply which the cravings of the young animal required whilst under the fostering care of our excellent Chargé d'Affaires, the Hon. W. Murray; to whom, after the princely donor, Abbas Pacha, zoologists at home are chiefly indebted for the present opportunity of studying this most remarkable and interesting African mammal, of which no living specimen has been seen in Europe since the period when Hippopotami were last exhibited by the third Gordian in the amphitheatre of Imperial Rome."

All observers appear to have agreed, that to see the hippopotamus rightly, is to see him in the water: there his activity is only surpassed by that of the otter or the seal. On making his first plunge into the bath, he generally goes to the bottom, and there remains entirely submerged for some seconds—the longest period is stated at three minutes and a half—and then quietly rises, until the large protruding eyes and valvular nostrils are above the surface. He frequently remains in this attitude for a considerable period; and then, as if suddenly possessed by some joyous sensation, plunges and rolls with gamboling glee, until the water dashes in waves against the sides of the bath. This and the house have been warmed by Mr. W. Hill's improved flue-boiler and furnace. The Hippopotamus proved, as was anticipated, the great attraction of the season: for several days subsequent to his arrival, the number of visitors at the Gardens averaged 2,000 per diem; and as many as 11,000 persons on Mondays.*

VISIT OF RARE WINTER BIRDS TO ENGLAND.

The severe and long-continued frost of the winter of 1849-50, as

* A statuette of the animal has been executed in "Parian:" it is very accurately modelled in outline and character, and deserves to become popular.

had been anticipated, brought to our shores some very rare visitants to the British Isles. Amongst these are specimens of the Black-throated Diver (*Colymbus Arcticus*), the Red-throated Diver (*C. septentrionalis*); the Sclavonian Grebe (*Podiceps cornutus*); the Red-breasted Merganser (*Mergus serrator*); and that exceeding rarity, the Pink-footed Goose (*Anser phænicopus*). This last species was first distinguished from the Bean Goose (*A. ferus*), which it closely resembles, by M. Baillon, in 1833, and by Mr. Bartlett, in 1839. Its peculiar characteristics are the shortness of the beak and the peculiar pink colour of the legs and feet. This goose is believed to breed in the outer Hebrides, and several were observed in the London markets in 1838, 1839, and 1840. Since those periods it has very rarely occurred in England. We have also been visited by a number of the beautiful Waxen Chatterer, or Bohemian Waxwing (*Ampelis garrulus*) Of this elegant species, no less than sixteen have been shot in the immediate neighbourhood of Doncaster. Four were killed near Conisbro', two at Warmsworth, and one near Hexthorpe. It is only at short intervals and during severe frost that this beautiful bird ventures to brave a passage from the Continent in search of the berries of the mountain ash and the hips of the wild rose, on both of which fruits it delights to feed. It is now thirteen years since any numbers of the waxwing—so called from the singular and brilliant wax-like appendages on the wing coverts—have been seen in this country.—*Doncaster Gazette.*

BIRDS OF THE FAROE ISLANDS.

A PAPER has been read to the British Association, by J. Wolley, Esq., on the Birds of the Faroe Islands, as observed by the author on a visit there in 1849. He gave a sketch of the relative situation, geological structure, and climate of the group, with a reference to their organic productions, as far as these had any bearing on the presence or absence of various kinds of birds. In illustration of the abundance of certain kinds of food, was mentioned the phenomenon of the sudden rise of a compact shoal of small marine animals, probably crustaceous; which, on the authority of an intelligent native, has given origin to the belief in the existence of the huge flat sea-monster, the Kraken of Pontoppidan, called in Faroe Kraka or Teara-bue. The particulars given by the Bishop, and those related by credulous eye-witnesses in the islands, are mostly consonant with this explanation. Such are the choice of particular localities—the sea-weed bank appearance, the birds hovering over it, and the fishes feeding upon its dung, with the calmness and heat of the weather; the latter also necessary for a sight of another of the sea monsters, the Soe-ormen, for which the effects of electrical jets of air, little whirlwinds or water-spouts, have undoubtedly been mistaken by at least some of Pontoppidan's witnesses. The snow bunting and the purple sandpiper, both of which frequent the tops of mountains, were the only species of bird not known to breed in Britain. The fulmar, about ten years ago, began to establish itself on the cliffs of Faroe for the first time. Many species reported to breed there by

other authorities were not to be found. Several traditionary particulars about the great auk were given.

NEW AFRICAN BIRD.

Mr. Gould has exhibited and described to the Zoological Society, a new form in birds obtained from the interior of Africa, by Masfield Parkyns, Esq. *Balœniceps rex* is a stock with a perfectly anomalous beak of immense power, somewhat resembling that of Cancroma, while in stature it nearly equals the Maraboa and Adjutant.

WINGLESS BIRDS.

Professor Owen has communicated to the Zoological Society, a Memoir (No. IV.) "On the Gigantic Wingless Birds of New Zealand." Having in the previous Memoirs determined and referred to their genera and species the different bones of the leg, he made those of the foot the subject of the present communication, which was illustrated by the exhibition of an extensive series of remains from both the north and south (or middle) islands of New Zealand; comprising the entire series of phalanges of one and the same foot of the *Palapteryx robustus*, a gigantic species from Waikawaite, a similarly complete series of the *Dinornis rheïdes*, and series, more or less incomplete, of the phalanges of the *Dinornis giganteus*, *Palapteryx ingens*, and other genera and species of the singular extinct wingless birds of New Zealand. The characteristics of the different phalanges were minutely detailed, and the different proportions of the toes characteristic of different species,—especially of the two most gigantic viz. the *Dinornis giganteus* of the North, Island and the *Palapteryx robustus* of the turbary deposits of the Middle Island. The adaptation of the claw-bones for scratching up the soil was obvious from their shape and strength. The generic distinction of *Palapteryx* had previously been indicated by a slight depression on the metal tarsus, supposed by the author to be for the articulation of a smal back toe, as in the Apteryx; and he had since received a specimen of the principal bone of that toe, which was exhibited and described. A nearly entire sternum, a portion of a minute humerus, a cranium of one of the larger species of *Palapteryx*, and a cranium of one of the smaller species of *Dinornis*, were also exhibited and described. This magnificent series of remains of the great New Zealand birds had been collected chiefly by the late Col. Wakefield, and had been transmitted to the author through the kind interest of J. R. Gowen, Esq., a director of the New Zealand Company.

Mr. Westwood has called the attention of the Linnean Society to the existance of a Wingless Bird on Lord Howe's Island, an island situate between New Holland and Norfolk Island. This spot had been accidentally visited by Capt. Poole, of the East India Company's service, who, considering it a favourable spot for colonization, had induced six Irishmen and their wives and families to settle on it. The place is now one of constant resort for the supply of water and provisions to the South Sea whalers. As no Government

has owned it, this island is at present the property of Capt. Poole. It is of considerable extent, and has on it two high hills, which can be seen at a distance of sixteen leagues at sea. On this island Capt. Poole had discovered the bird in question. It is about the size of a rail, and is considered by the settlers as good eating. Mr. Westwood thought the announcement of the existence of this bird, which was not previously known to exist in those regions—would be received with interest in connection with the discovery of the extinct wingless birds of New Zealand.

THE NOTORNIS.

Dr. Mantell, has read to the Zoological Society, a " Notice of the Discovery by Mr. Walter Mantell, in the Middle Island of New Zealand, of a living specimen of the Notornis, a bird of the Rail family, allied to *Brachypteryx*, and hitherto unknown to naturalists except in a fossil state." It was in the course of last year, on the occasion of Mr. W. Mantell's second visit to the south of the Middle Island, that he had the good fortune to secure the recent Notornis. This bird was taken by some sealers who were pursuing their avocations in Dusky Bay. Perceiving the trail of a large and unknown bird on the snow, with which the ground was then covered, they followed the footprints till they obtained a sight of the Notornis, which their dogs instantly pursued, and after a long chace, caught alive in the gully of a sound behind Resolution Island. It ran with great speed, and, on being captured, uttered loud screams, and fought and struggled violently. It was kept alive three or four days on board the schooner, and then killed ; and the body roasted and ate by the crew, each partaking of the dainty, which was declared to be delicious. The beak and legs were of a bright red colour. Mr. W. Mantell secured the skin, together with very fine specimens of the Kakapo or ground parrot (Strigops), a pair of Huias (Neomorpha), and two species of Kiwi-kiwi, namely *Apteryx Australis* and *Ap. Oweni*. The latter very rare bird is now added to the collection of the British Museum. Mr. W. Mantell states that, according to the native traditions, a large Rail was contemporary with the Moa, and formed a principal article of food among their ancestors. It was known to the North Islanders by the name of "Moho," and to the South Islanders by that of "Takahé ;" but the bird was considered by both natives and Europeans to have been long since exterminated by the wild cats and dogs ; not an individual having been seen or heard of since the arrival of the English colonists. On comparing the head of the bird with the fossil cranium and mandibles, and the figures and descriptions in the *Zoological Transactions* (Pl. 56), Mr. W. Mantell was at once convinced of their identity. In the course of Mr. W. Mantell's journey from Banks' Peninsula along the coast to Otago, he learned from the natives that they believed there still existed in that country the only indigenous terrestrial quadruped, except a species of rat, which there are any reasonable grounds for concluding New Zealand ever possessed. While encamping at Arowenua,

in the district of Timaru, the Maoris strongly asserted that about ten miles inland there was a quadruped which they called Káurĕke, and that it was formerly abundant, and often kept by their ancestors, in a domestic state, as a pet animal. It was described as about two feet in length, with coarse grisly hair, and must have more nearly resembled the otter or badger than the beaver or the ornithorynchus, which the first accounts seemed to suggest as the probable type. The offer of a liberal reward induced some of the Maoris to start for the interior of the country where the Káurĕke was supposed to be located; but they returned without having obtained the slightest trace of the existence of such an animal. Dr. Mantell, in concluding this brief narrative of the discovery of a genus of birds once contemporary with the colossal Moa, and hitherto only known by its fossil remains, remarks, that this highly interesting fact tends to confirm the conclusions expressed in his communications to the Geological Society; namely, that the *Dinornis*, *Palapteryx*, and related forms, were coeval with some of the existing species of birds peculiar to New Zealand, and that their final extinction took place at no very distant period, and long after the advent of the aboriginal Maoris.

Mr. Gould then addressed the meeting, and pointed out the zoological characters of the bird discovered by Mr. Mantell, which he had no hesitation in identifying as the species formerly characterised, from its osseous remains, by Professor Owen under the name of *Notornis Mantelli*. Mr. Gould, in adverting to the extreme interest with which the present existence of a species which was certainly contemporary with the Moa must be regarded, pointed out from the preserved skin which was on the table how accurate a prevision of its character had been made by Professor Owen, when investigating the fragments from which our first knowledge of it had been derived. Professor Owen made some remarks upon the probable causes of the extinction of the larger species of wingless birds, and in doing so paid a tribute to the indefatigable zeal of Mr. W. Mantell in advancing scientific inquiry in New Zealand.

The above specimen of the Notornis has been figured in the *Illustrated London News.*

NEW FISHES FROM LAKE SUPERIOR.

Professor Agassiz describes an account of two New Fishes obtained by him at Lake Superior, which he regards as types of two new genera. The first is an entirely new type in the class of fishes. It is a small fish, five or six inches long, which, in some respects, resembles several families, but is most like the Percoids, though distinct from them. Fossil species with similar characters are found in the cretaceous formation. This is the second, Professor Agassiz remarked, of the "old-fashioned" fishes, so to speak, corresponding in their structure to a fossil species, which has been observed in this country. The other fish is the only living representative of a large family of fossil species. The existence of these two species has undoubtedly reference to the fact, that America is the oldest extensive continent which has been upheaved above the level of the sea. In

New Holland two genera exist bearing similar relations to older families—a fish and a shell—which have their analogues among the oolitic deposits.—*Proc. Boston Nat. Hist. Society.*

ADDITIONS TO THE IRISH FAUNA.

Dr. Farran has made two interesting additions from the south coast of Ireland. One of them, it is said, is the red band fish, or red snake fish (*Scholas rubescens*). Its colour is fine rose-red, bands of darker hue encircling it, and giving it the appearance of a snake. It is of frequent occurrence on the Cornish coast; but hitherto it had not been seen in Ireland, where it is now discovered that it inhabits the submarine forests of sea-weed, particularly the laminaria, which grows in great abundance and luxuriance about a mile from shore, and in four or five fathoms of water. It is found on the beach only after a severe gale, and has never been known to take the bait. Its length is about 16 inches. The other novelty is the *Pholas papyracea*,—a shell unrivalled in beauty and singularity of structure. This shell, though never heretofore found in Ireland, is tolerably abundant in Devonshire, and typifies a peculiar deposit, the red marl—in that county. Dr. Farran discovered it in a position and formation greatly at variance with its English habitat—that is, in a submerged bog directly under his house at Clonea, near Dungarvan, and in company with three other *Pholadæ.—Saunders's News Letter.*

CUNNING OYSTERS.

By a treaty made between England and France in 1838, it was agreed that the ocean within the coasts of both countries should be considered as belonging to both, with the exception of the coasts between Jersey and France, where a line had been drawn, beyond which, on either side, the fishermen of the respective nations were not to encroach. A multitude of Cunning Oysters, taking advantage of the neutral ground, have made their bed exactly upon the line; and, as they are of excellent quality, the temptation is too strong for the fishermen on both sides. They are continually encroaching on each other's ground. The consequence has been that several French fishermen have been taken and fined by the English, and several English by the French.

THE OPAH.

A fine specimen of the Opah or King-fish (*Lampris guttatus*, Retz. Cuvier; *Zeus Luna*, Gmel. Linnæus) is described in the *Darlington and Stockton Times* as recently taken by Mr. Wrightson. This fish is very rare, only eight specimens having been captured on the British coast. It is a native of the Eastern seas, and is regarded by the Japanese as devoted to the Deity, and as being the peculiar emblem of happiness. The length of the body, including the tail, is to the depth of the body without the fins as 2 to 1. The form of the body is oval; the profile of the head, both above and below, fall-

ing in with the outline of the body. The scales are exceedingly small. The mouth is small, and without teeth; the tongue thick, with rough papillæ pointing backwards; the base of the dorsal fin is rather longer than the depth of the body; the first eight or nine rays elongated. The pectoral and ventral fins are very long; and the anal fin equal in length to half the length of the base of the dorsal. Tail in shape lunated; ventral, pectoral, and anterior part of the dorsal fins, falciform. The lateral line forms an elevated arch over the pectoral fin, its highest part being immediately under the longest ray of the dorsal fin. The colour of this specimen is very beautiful. A bright crimson or vermilion is the prevailing hue, shot or shaded in parts by purple and gold, and studded by silver spots. The fins are an intense vermilion.

FRESHWATER POLYZOA.

There has been read to the British Association, the Report called for at the Meeting in 1849, "On the Present State of our Knowledge of the Freshwater Polyzoa," by Professor Allman. Freshwater Polyzoa have, in a zoographical point of view, been examined chiefly by Gervois and Van Beneden, on the Continent; and in this country by Sir J. G. Dalyell; while Van Beneden and Dumortier have given us valuable details of their anatomical structure: and recently Mr. Hancock has published an excellent paper on the anatomy of certain genera, with descriptions of some new species. Still, however, much remained to be determined, and in the present report Prof. Allman brought forward the result of several years' laborious research into this subject. In consequence of our increased knowledge of the Polyzoa and their separation from the Polypes, rigid exactness as well as facility of description required some reform in the terminology hitherto employed in speaking of these animals, and which contained several terms also applied to the Polypes, and consequently to parts in no respect homologous. The Report contains a detailed account of the anatomy of the different genera in which the dermal, digestive, respiratory, circulatory, muscular, nervous, and reproductive systems, are described under distinct heads. Prof. E. Forbes said that such papers as these afforded abundant evidence of the value of the services of the British Association to science. This report, with many others, bringing up our knowledge of science to the present day, would not have been produced but for the Association.—*Athenæum*, No. 1190.

LOCUSTS IN SAVOY.

On June 25th, 1850, some Locusts appeared in Savoy. They were at that time without wings, or, in other words, in the larvæ state, which tends to confirm the observations of certain gentlemen, who assert they saw them in small numbers in the previous year. The larvæ observed towards the end of June covered the right bank of the Isere, about 500 yards from the village of Po, near the town

of St.-Pierre d'Albigny. They advanced slowly, and spread over the gravel and rugged stones of the bank, swimming across the pools and watercourses which they encountered. They remained here about three weeks; they then underwent their last transformation, and acquired wings; they subsequently dispersed after a severe storm which occurred on the 22d of July. On the 2d of August some were picked up at Chambery, and on the 4th they were found even at Aix. On the 26th of July, when MM. Génin and Bonjeau first observed them, they were nearly all winged; there were but few larvæ. They were dispersed over the right bank of the Isere, covering a space of from 3,000 to 4,000 yards long by about 500 wide. The earth passed over by them was strewed with their excrements, which, in form and colour, resembled grains of corn. A chemical analysis of the excrements showed them to be composed of the woody matter of the plants over which the insects had passed. The damage done was estimated by MM. Génin and Bonjeau at one-half of the marsh plants, one-hundredth part of maize seed, and one-twentieth of the leaves of the same plants: other plants suffered little. The locust appears to be the *Œdipoda migratoria;* it has not been known to have visited Savoy before. The specimens of it to be found in the Museum of Natural History of Savoy were obtained from Algiers.—*Comptes Rendus.*

GIGANTIC LAND TORTOISE.

An enormous Land Tortoise has been brought to England from the South Seas, by Captain Brown, in Her Majesty's ship *Geyser*, as a present to Queen Victoria, from Dr. Shea, Surgeon to the Royal Naval Hospital at the Cape of Good Hope; and has been presented by Her Majesty to the Zoological Society.

This gigantic tortoise is stated to be a native of the Gallipagos Islands, and was taken to the Cape of Good Hope, a few years since, in a whaler. Its length is exactly seven feet, measuring from the point of the nose to the extremity of the tail, including the curve of the back: its height, when walking, is three feet; and the circumference of the body, at the largest part, seven feet eight inches. The head is only eight inches in length, and six in breadth, being very small in proportion to the size of the body, which is the case in all animals of this class. The legs are each one foot six inches in circumference, and the strength of the animal is in proportion to their size; for, torpid and lazy as it may appear, it will carry three or four men, standing upon its back, with apparent ease. It weighs about five hundred pounds, and its age is supposed to be not less than one hundred and eighty years.

SERPENT-CHARMING.

Some healthy Egyptian Cobras have been brought to England for the Menagerie of the Zoological Society, where, in fine weather, they perform with two charmers, an old man and a lad. It is essential

that the weather be fine, for so delicate are the serpents that they will not stir out if there be a drop of rain. The charmers handle the Egyptian cobra, which they call *taban nouascher*, in a manner which evinces their entire fearlessness of its bite. They irritate it, soothe it, receive its open-mouthed attack, or its gentle caress, as their own caprice, or the request of the spectators, may suggest.

The serpents are kept in a square box, provided with hay. They have flat, leaf-shaped heads: they appear anything but fierce; the keepers of the Gardens handling them with indifference. The boy performer occasionally utters a few quick words, at which the serpents sharply turn their heads, as if in reply. He first takes one from the box; he caresses it, and the serpent rises on its belly, as if entranced; he hits it with a small bamboo, when the serpent flies quickly round, and this being repeated, darts its tongue at the boy. He is not afraid, but pinches and pulls the serpent by the tail, and knocks it on the head. It now becomes more exasperated, and, rearing itself as high as possible, darts at the boy's hand, when he seizes it in the middle of the body, blows or spits into its distended jaws, and throws it on the boards, where it falls, dank and limp, like a coil of rope, and there remains motionless until touched again; when, after being passed twice or thrice through the boy's fingers, it recovers its activity, and, on being placed again on the ground, exhibits itself instantly in as rapid motion as if no interruption had occurred to it. Lastly, three or four other cobras are placed upon the floor, when they raise themselves in various fantastic forms; and the performance closes by the boy twisting the serpents round his neck, and thus walking off with them.

CAUTERIZATION IN THE CASE OF POISONOUS BITES.

In the *Comptes Rendus* for January 8th, we find an article by M. Parchappe, containing the result of his observations on the question whether the spread of poison produced by a bite can be prevented by cauterizing. He was induced to examine into this subject, because M. Renard had stated that cauterization was found to have no effect when applied even within five minutes after the bite in the cure of one sort of virus, and within one hour in that of another. These results, he was aware, though derived from experiments upon animals, would weaken the confidence of physicians and patients in the only mode that medicine possesses of preventing the bad effect of a bite from any poisonous animal; where, as is generally the case, some considerable time must elapse before the remedy can be applied. M. Parchappe accordingly made several experiments upon dogs with an extract of nux vomica, all of which go to confirm him in ascribing to cauterization a power even greater than that commonly allowed it. "From these experiments it results that the immediate amputation or destruction in the living portion with which the extract of nux vomica has come in contact, has the power of preventing the bad effects of the poison, even when it has been in contact for some time." The author is aware that there is considera-

ble difference between the virus of animals and the substance used by him, with reference to their direct and remote effects, but thinks that every one must admit that there is a great *analogy* between them; is of the opinion that in both cases the poison remains in the bitten part for a considerable time before it is transmitted to the rest of the body, and that cauterization should be adopted in all cases where a poisonous bite is even suspected.

PRESERVATION OF INSECTS.

Mr. Douglas has read to the Entomological Society, a letter from Mr. E. Wilson, in which it was stated that in the United States it was impossible to preserve a collection of insects of any extent: as in some years, during the very hot weather, owing to a peculiar state of the atmosphere, everything that was closely shut up became covered with a white hoar, and that from this cause a pair of boots in a cupboard would become as white as snow; and that, in order to guard against these sudden attacks, the cases of birds at the Academy of Philadelphia, instead of being closed as they are in this country, have chimneys to cause an artificial draught; and every box of insects is required to be opened during the continuance of these attacks, so as to expose them as much as possible to the air.

DESTRUCTION OF WASPS.

The annual sport among the youths of Traquair came to a close on the 1st of June. From the results we find that the yellow game has not been so plentiful this season as in some former years; consequently the sportsmen have bagged less game, and also less money than usual. Notwithstanding, the Earl of Traquair is most anxious that all the young people in the district should show their dexterity by coming every week in the months of April and May with a large number of wasps, for which they receive ready money. In 1844 there were destroyed 224 dozen; in 1845, 1,573 dozen, weight 4lbs. 9½ oz.; in 1846, not a wasp to be found; in 1847, 4 dozen only, weight 4 oz.; in 1848 there were destroyed 1273½ dozen, weight 4lbs. 7 oz.; in 1849, 856½ dozen, weight 2 lbs. 8 oz.; in 1850, 528½ dozen, weight 1 lb. 11½ oz. Total, 4,459½ dozen, weight 9 lbs. 8 oz., during the last seven years, or rather five years, as in 1846-7, only four dozens were taken: these dozens will make the number of wasps to be 53,514 in a circuit of three miles. Now if all, or even one-half, of the proprietors in the country would use the same means to exterminate these insects, a wasp would soon be as rare a sight as a red deer on the hills around us.—*Edinburgh Evening Courant.*

THE CIGAR DESTROYER.

At a late meeting of the Entomological Society, Mr. Westwood stated that M. Guérin-Méneville, in his researches on Insects de-

structive to Tobacco, had found that many different species fed thereon. One of these, a new species named *Catorama Tabaci*, he at first thought was allied to the genus Ptinus, but afterwards found it more nearly related to Dorcatoma. In this latter genus he had been able to clear up the doubts as to the number of joints in the antennæ (which had been variously stated by different authors to be 8, 9, 10, and 11); having determined from the examination of two specimens that the real number was ten in the male and nine in the female. Another species detected by M. Guérin-Ménèville was *Xyletinus serricornis*. Now, Mr. Westwood had recently had a pupa sent to him in a cigar which he believed was this species. The cigar purported to come from Havannah; now *X. serricornis* being a North American species, it appeared to him to throw some doubt on the genuineness of the Havannah cigar. In this view Messrs. Wilkinson and Douglas did not participate, thinking it quite possible that the insect might have transferred itself from tobacco of one country to tobacco of another whilst in the bonded warehouses. The President observed that many insects were found all over the world, instancing the species of *Dermestes* and *Trogosita Mauritanica*, and that it remained to be proved that the beetles referred to were peculiar to one country. Mr. Saunders stated that he had lately received a letter from Mr. Harrington, dated at sea, the 7th of October last, in lat. 17 S., long. 35 W., in which the following passage occurred:—I have taken two very beautiful moths, decidedly exotic—one in lat. 27° 36′ N., lon. 19° 34′ W.; the other in lat. 13° 12′ N., lon. 24° 32′ W., and three beetles a few miles south of the line." The distances from land in these positions would be respectively 80, 90, and 240 miles.—*Athenæum*, No. 1206.

THE TSETSE AND ZIMB.

MR. WESTWOOD has read to the Zoological Society, a paper "On the Dipterous Insects of Africa known under the names of the Tsetse and Zimb." After noticing the different modes of attack of insects on horses and oxen, together with the effects thereby produced, a new species from the neighbourhood of the New Lake was described, under the name of *Glosina morsitans,* which had been observed by Capt. F. Vardow to attack horses, occasionally causing their death. Mr. Westwood referred to the description of the Zimb given by Bruce; and considered that that writer had united in one account the attacks of the Tsetse and those of the species of Æstrus which infest the camel, rhinoceros, &c. Descriptions were added of two additional species of Glossina, from Western Africa, and of a new and remarkable allied genus from Sierra Leone.

NEW ACARUS.

MR. NEWPORT has described to the Linnæan Society, a new Acarus, *Hetcropus ventricosus* (Newport), a parasite in the nests of *Anthophora retusa*. The new Acarus belongs to the tribe Sarcoptides of Koch. At the time of its first appearance, it is stated to measure

only about sixteen-thousandths of an inch in length; yet it destroys the young of the bee which it attacks.

CURIOUS LARVA.

There has been read to the Entomological Society, an extremely interesting notice, by Mr. Jordan, of a small Lepidopterous Larva (probably of the genus Goniodoma), which fed on the flowers of *Origanum vulgare*, in a case precisely resembling an unexpanded flower bud of that plant.

BOTANY.

INFLUENCE OF SALT ON VEGETATION.

Dr. Voelcker has detailed to the British Association the result of a series of experiments on the Influence of solutions of Salt on various Plants,—as cabbages, beans, onions, lentiles, chickweed, groundsel, the thistle, radishes, and some grasses. None of the plants were affected during one month by solutions containing 24 grains of chloride of sodium to the pint of water, with the exception of *Anthoxanthum odoratum*, which was killed. Cabbages, radishes, and lentiles, were benefitted by this solution, and not injured by solutions containing 48 grains to the pint. Solutions of 96 grains injured the others, but had no effect on onions, radishes, and *Carduus pratensis*. Onions were not injured by solutions containing 192 grains of salt in the pint. Many of the plants had taken up so large quantities of salt that they tasted like strong brine. Prof. Walker-Arnott said that some of the plants experimented on by D. Voelcker, although not exclusively sea-shore plants, were yet of a kind that would grow near the sea; as, for instance, *Poa annua*, and he knew as a fact that the seeds of plants which grew near the sea would bear larger species of salt than those of the same species which grew away from the sea.

CYCAS REVOLUTA IN BLOOM.

In June last, a very fine specimen of *Cycas revoluta*, (Sago Palm,) bloomed in a pine-stove, in the gardens of Lord Ravensworth, of Ravensworth Castle, in the county of Durham. The plant is supposed to be about fifty years of age, and had never bloomed before. The flower was of a fine yellow colour. The trunk, at the base, measures in circumference 2 feet 5½ inches; 2 feet 10½ inches where the leaves project; and stands 2 feet 8 inches high. The circumference of floral leaves is 3 feet 4½ inches, the flower of which appeared to form on the base of the leaflets, in the shape of glands. The *Cycas revoluta* is a native of China, and was introduced into England by Thunberg, in 1737.

"ROPY BREAD."

DR. LANKESTER has read to the British Association, a paper from Mr. G. Read, "On the subject of Ropy Bread." This kind of bread, which is unpleasant and almost useless, is not unfrequent. It occurs at times throughout a whole district, and when it once gets into the bakehouse it is with difficulty expelled. The only way to get rid of it is to cast away all the old materials of bread-making, and use everything clean and new. When examined under the microscope, the bread was found to have lost much of its cellular character, and everywhere the presence of a minute fungus could be detected.

EXPERIMENT ON A DRAGON TREE.

DR. MACKAY, of Dublin, has given to the British Association an account of an experiment on a *Dracæna Draco* (Dragon Tree) in the Botanic Garden of Trinity College, Dublin. The plant had grown too tall for the house which it was in, the stem was gradually cut through four feet above the surface of the soil, and the upper part suspended in the air, when it sent down secondary roots, and eventually was planted again. The author thought that the same plan might be pursued with regard to the palms and other Endogenous plants when they became too tall for the house.

THE GRASS-CLOTH OF INDIA.

DR. H. CLEHORN has illustrated to the British Association the economy of the Grass-cloth (Chū Inā) of India. The author stated that several species of plants belonging to the order Urticaceæ were employed in Hindustan for yielding fibres used in the manufature of textile fabrics. He exhibited several articles of dress, very white and light, which were made from the fibres of an Urticaceous plant, the *Bohmeria nivea.* Mr. Gourlie, of Glasgow, stated that we knew very little of the raw material of many of the fabrics from other parts of the world. We were for a long time ignorant of the materials from which Manilla handkerchiefs were made. It was said to be the fibre of the leaf of the pine-apple, but we had not succeeded in manufacturing them in this country. Dr. Lankester remarked, that although the exhibition of raw materials in the coming Exhibition of 1851 had been deprecated by some, he believed that it might be made one of the most important and valuable features. Dr. Royle said that it had long been doubtful what plant yielded the grass-cloth of India, and now that we knew the plant, it would undoubtedly lead to its further employment. There were many other fabrics in India, of which we knew nothing of the materials. He thought that one of the most important branches for the manufactures of this country of the Exhibition of 1851 was that of raw materials. Every pains should be taken to obtain the name and history of every species of plant which yielded any substance useful in the arts, manufactures, or medicine.

WATER OF THE SERPENTINE IN HYDE PARK.

Dr. A. Hassall has read to the Botanical Society, a paper "On the Colouration of the Water of the Serpentine." In this communication it was shown that the periodical and vivid green colouration of the water of the Serpentine is due to the presence of a minute plant belonging to the tribe of Algæ,—of which the writer gave a detailed and critical description, and which he named *Corriophytum Thompsoni.* The development of this plant takes place early in the spring, out of sight and at the bottom of the water; and it is only on the approach of the warm weather of summer that it diffuses itself through the water, deeply colouring it; and that part of it rises to the surface, forming a scum or pellicle of a bright æruginous or coppery green colour. The whole of the water of the Serpentine is not usually coloured at one time, but different portions of it at different times, according to the strength and direction of the wind, which drives the plant before it. At one time it is found collected in the Hyde Park extremity, at another it is present in the Kensington division, sometimes at the north and and at others on the south shore, the remaining parts of the Serpentine being entirely free from the plant. This variable distribution, which, unexplained, would be apt to occasion surprise, accounts for the fact that the observer may sometimes visit the Serpentine and not see a trace of the plant in question; and hence he might be led to form an erroneous conclusion as to the condition of the water. Considered in a sanitary point of view, Dr. Hassall is of opinion that the plant when actually introduced into the system—as when swallowed in bathing—would not be productive of effects injurious to health, and regards it as a test of impurity, and as an evidence of the very bad condition in which the water of the Serpentine now undoubtedly is. Dr. Hassall concluded the communication by observing that the colouration of large pieces of water by means of confervæ is by no means unfrequent; and cited as a remarkable instance of it the Red Sea, which owes its name and colour to the presence of a minute plant, diffused through the water, of a blood-red colour.

MUSEUM IN THE ROYAL BOTANIC GARDENS AT KEW.

The leading characteristic of this collection is its great variety of manufactured specimens of vegetable substances; the inspection of which adds even a charm to the Gardens.

The Museum is a plain building, in size and style resembling that in the Gardens of the Zoological Society. The objects are exhibited in cases fixed to the walls, and in a double row in the centre, all ticketed in plain language, and of a character to interest the least educated person; and consisting generally of the raw and manufactured produce of the vegetable kingdom.

Among the specimens are straw and grasses, beautifully worked up; cotton, in all its stages of perfection; flax, from the rude stem to its manufacture into the most costly fabrics for dress or the table; native cloths from New Zealand, China, Ceylon, the Sand-

wich Islands, and some of very delicate texture and elegant design, made of grasses, palm fibres, and paper-mulberry; India-rubber and gutta percha in every form; also teas, of which many varieties are almost unknown in Europe; coffee, sugar, spices, gums, resins, drugs, and woods for dyeing; seeds, leaves, and roots used in medicine. Such fruits and produce as cannot be dried are beautifully preserved in spirits. Among foreign and British woods, polished and unpolished; one case, in particular, contains sixty-six varieties of Brazilian woods, collected at Candoza, by John Taylor, Esq. An exceedingly curious and important series consists of specimens showing the internal injuries produced by pruning timber, and also by insects.

There is a small, and, it is to be hoped, increasing collection of flowers and trees, painted from the life, with full descriptions. Two of them must not be passed over: the side-saddle plant (*Sarracenia purpurea*) of South America, the serrious tabular leaves of which have a number of inverted leaves at the mouth, which facilitate the entrance of numerous insects, but retain them until they die, being nourished by animal juices; and the *Omiranda fenestralis*, the leaves of which are natural skeletons, the places between the vascular tissues never being filled up.

There is a collection of tropical fruits, modelled in wood and coloured from nature.

Some very beautiful household utensils, made in Para, have been presented by Sir E. Horne: they are formed of the ashes of the *caripá*, or pottery tree, mixed with clay, and they neither break nor burn in the fire.

An elegant coronet, brought from the South Sea by Captain Kellett, R.N., is made of the young cuticle of palm leaves, and looks like shreds of gold, curled.

Various sea-weeds, used as food, both in savage and civilized life, are exhibited; as also bread made of seeds, bark, berries, and pollen.

That remarkable and indispensable tree of the tropics—the palm—is richly illustrated in its produce, uses, and most wonderful spadix or fructifying flowers, especially those of the *Maximiliana regia*, presented by E. G. Boughton, Esq., of Demerara. A cluster of cocoa-nuts, truly gigantic, presented by N. B. Ward, Esq., and the double cocoa-nuts of the Seychelles Islands, are very fine. There is a portion of the trunk of an eta palm, which measures 71½ feet from the ground to the first leaves, brought from Para.

The curious bunches of the *Nipa furticas*, from Malacca, were presented by Sir W. Norries. Wax is shown, as scraped from the Wax Palm, and candles made of it; as also some made of acorns, and closely resembling common tallow; with *Noli*, scraped from the base of palm leaves, used as matchlock tinder in Malacca; and a sort of cotton, from the *Elais melanococo*, with which they kindle fire; also, a portion of the aerial roots of the *Ariactea exorluza*, used by the natives of New Grenada as a grater. A white hat, made of pith taken from the palm tree, was brought from Singapore. Hats and

cloaks, made of the fibres of palms, and quite waterproof, are exhibited, from China, Ceylon, and New Zealand; the body-cloth of the Dyaks of Borneo, made of the same fibres; and aprons of the Navigators' Islands, made of leaves cut and closely strung. A shawl, made in Manilla, of the fibres of the *Musa textilis*, and beautifully worked, is equal to the finest cambric.

Some whips, from Jamaica, are made of the leaves of the lace-tree, and ornamented with bunches of the same, which, from their delicate pen-work appearance, derive their name.

Captain Boscawen Ibbotson has presented some beautiful specimens of silver and copper electrotypes of skeleton leaves and flowers, which vie with the most delicate filagree work; and some small beetles, by the same process, resemble frosted silver. The skeleton leaves, fruits, and flowers, are prepared by Mrs. M'Lean Smith, of Chelsea, who has presented some flowers and leaves, in colour and texture like white lace.

Some approximate analyses are shown of the substances contained in bread, potatoes, &c., made by Professor Henslow.

Here are concrete milk and butter, made from the trees of that name in Para: also, cones, seeds, pods, nuts, and berries from all parts of the world; among them acorns as large as a wine glass, which are found growing on the Himmaleh Mountains, in clusters several hundred together. There are some stems of Brazilian thicker than a large arm, which hang 100 feet or more from the top of the loftiest trees in the forest, and render it quite impenetrable to man. In proof of the extreme fertility of grain, there are shown the stalks of some gigantic potato oats, produced from a single grain, which contained 1750. Some very singular natural sacks are shown, as stripped from the tree of that name growing in Bombay; they are from six to eight feet high, and in appearance like felt, the only joining being at the bottom.

Many elegant gourds and calabashes are here collected: the snake viper gourd resembles a convoluted serpent, having the extremity pointed, and the part by which it is attached formed like the head; a miniature gourd of Thibet, of elegant portions and bright scarlet colours, is used by the Lepelia Tartars as a snuff bottle. A portion of a matted mass of willow-ash root fibres, measuring 18 feet long and $1\frac{1}{2}$ foot round, which had choked up a drain at Hitcham, in Suffolk, is a remarkable proof of the power of vegetable life to force and sustain its vigour under the most unnatural circumstances.—*Communicated to the Illustrated London News*, No. 445.

THE FUNEBRAL CYPRESS.

Amongst recent importations of hardy ornamental evergreens, calculated to afford hereafter a new feature in our garden and landscape scenery, there is nothing to rival this beautiful tree. The traveller who appears originally to have noticed the Funebral Cypress *(Cupressus funebris)*, or at least the first who has left any recorded facts in relation to it, was Sir George Staunton, when ex-

ploring China in the embassy of Lord Macartney. Subsequently, however, Mr. Fortune met with it near the celebrated tea country of Whey Chow; and through the interest of that gentleman, Messrs Standish and Noble, of the Bagshot Nurseries, in Surrey, have been enabled to import both seeds and young plants.

Mr. Fortune describes this Weeping Cypress as quite new; it is a noble-looking fir-tree, about sixty feet in height, having a stem as straight as the Norfolk Island pine, and pendulous branches like the weeping willow. The branches grow at first horizontally with the main stem, then describe a graceful curve upwards, and droop again at the points. From these main branches, others, long and slender, hang down towards the ground, and give the whole tree a weeping and graceful form. It is also very symmetrical, and reminds one of a large and gorgeous chandelier. In regard to its effect in scenery, Mr. Fortune remarks:—"It has a most striking and beautiful effect upon the Chinese landscape, and in a few years the same effect will, doubtless, be produced by it upon our own. It will be particularly valuable for park scenery, for lawns, for the entrance to suburban residences, and as an ornament for our cemeteries. I have no doubt that it is quite as hardy as *Cryptomeria japonica* and the Indian Deodar, and will be a fit companion for both in our parks and pleasure-grounds." The fact of its being perfectly hardy, as conjectured by Mr. Fortune, has now been perfectly established—hundreds of young plants have stood the past winter uninjured in the Bagshot Nurseries; some young seedlings, in a growing state, were removed from a cold house to the open ground without protection, and subjected to eight degrees of frost, in the first week in May, without injury.

THE PALMYRA PALM OF CEYLON.

An interesting "Description of the Palmyra Palm of Ceylon, *(Borassusflabelli farmis)*, by William Ferguson, has lately been printed and published in Colombo. In this work, the author combines a scientific description with a popular account of the tree; its various economical uses, including the mode of obtaining toddy from it; its value as a sugar-producing tree, and the employment of its leaves for books, letters, &c.; illustrated with woodcuts from drawings by Ceylonese artists; besides a variety of other information respecting this most important of the Indian Palms, next to the Cocoa-nut.

Geology.

A PROOF OF THE CORRECTNESS OF THE GLACIAL THEORY.

Professor Agassiz has referred to a rock at the south entrance of the bay of Lake Superior, which he considers a proof positive of the Correctness of the Glacial Theory. Its surface is a couple of hundred yards in extent, sloping regularly north to the water's edge. The whole is polished and scratched, except where disintegrated. The scratches have two directions, the prevailing one north 10° to 30° west, the other north 55° west. The scratches on the outer or lake side seem to have a rather more westerly direction than the rest. Great numbers of these striæ can be traced below the water's edge, from which they ascend in some places at an angle of 30° with the surface; showing, as the Professor remarked, that they could not have been produced by a floating body. The rock is granitic, with an astonishing number of veins and injections of epidotic felspar, granite, and trap; often crossing each other, so as to form a complicated net-work. Wherever exposed, it was ground down to an even surface.—*Agassiz on Lake Superior*, p. 50.

PALÆOZOIC ROCKS OF THE SOUTH OF SCOTLAND.

Professor Sedgwick has described to the British Association, the Palæozoic Rocks of the south of Scotland. After referring to the formations which surrounded them, and to the deposits which occupy a higher geological position, the Rev. Professor said he had endeavoured to ascertain the axis of the great mountain-chain which traversed the south of Scotland. He believed that the axis was at the centre—that was to say, that newer rocks were to be found on the north and south sides of it. He then went on to say, that in this great mountain-chain beds exist which are nearly equivalent to the Caradoc sandstone of Sir Roderick Murchison; and also to the Conniston limestone of the high part of Lancashire, where it adjoins Cumberland. These beds were marked by the fossils which characterized the Silurian of his friend the Chairman. Such deposits occurred at Girvan, Colmonell, in Ayrshire, and in some parts of Wigtonshire, and at Balmea, in Kirkcudbright. Below these beds Graptolites are found, and these Graptolites are of such a nature as to connect them with the black slates of New York, in which fossils of a similar nature occur. He had figured in a work, which would appear before long, thirteen different species found here, which were described only in American works. In Scotland these Graptolites are most abundant about Moffat, the so-called alum slate being full of them. This portion of the palæozoic formation the learned Professor conceived to be much below any beds which have hitherto afforded fossils, and he believed that his friend Sir Roderick's system would have to undergo some change before the palæozoic rocks of the south of Scotland could find a place in that arrangement. The Professor then alluded to the relative position

of the lower beds, which he conceived are much better developed on the south portion of the range than on the north; and concluded by observing, that we must refer to the palæozoic rocks of America, before we can obtain a correct idea as to the position of these beds as they occur in the south of Scotland.

DISPERSION OF GRANITE BLOCKS.

Mr. Hopkins has made to the British Association a statement on "the Dispersion of Granite Blocks from Ben Cruachan." He stated that he had detected them on the beach about Oban, in considerable mass to the northern extremity of the island of Kerrera, and across nearly the summit of the island. He also found many blocks on the shores of Loch Lomond, Loch Long, and Lochfine, which he thought might be traced to Ben Cruachan as their original source. His observations were as yet imperfect, but he hoped, in the course of the present summer, to complete them. He argued that glaciers must have been effective in transporting the blocks from some of the higher parts of the mountains to those of the lower levels, when they might be subject to other causes, such as floating ice and diluvial currents; and he conceived it highly probable that the surface of the land of this region had, during the glacial epoch, been submerged considerably beneath the surface of the sea; and that a complete transport of the blocks had been effected by a combination of the actions of the glaciers, floating ice, and currents.

ON THE PARALLEL BETWEEN THE SUPERFICIAL DEPOSITS OF THE BASIN OF SWITZERLAND AND THOSE OF THE VALLEY OF THE PO, IN PIEDMONT. BY MM. MARTINS AND GASTALDI.

1. *Ancient moraines.*—In proceeding from the higher to the lower ground in both basins they met with numerous ridges, formed of erratic block, striated pebbles from the Alps, sand, gravel, and clay mixed together, without any trace of stratifaction, indicating the long existence of glaciers. In Switzerland, Berne, Sursee, and other towns, are built on moraines; and examples were seen in the great moraine of Mont Sion, between Geneva and Anney, and that of the ancient glacier of the Rhone, extending from Fort Ecluse to Soleure, along the eastern declivity of Jura. In Piedmont, the moraine of Rivoli, at the opening of the valley of Susa, that of Ivrea formed by the ancient glacier descending from Mont Blanc, Mont Rose, and Mont Coque, filling the valley of Aoste and extending over the plains as far as Calasso. 2. *Scattered erratic formation*, composed of gigantic angular blocks from the Alps, gravel with striated angular pebbles, and mud, brought down by the glaciers at the period of their greatest extension. In Piedmont it forms a band round the moraine, and is seen on the hill of Superga. In Switzerland it covers all the plain, from the lake of Geneva to the lake of Constance, and penetrates the valley of Jura. 3. *Glacier diluvium*, formed of rolled and rounded pebbles from the Alps, which are never striated; it is sometimes stratified, but without fossils. It covers a great part of

the basin of Switzerland, and is very deep round Geneva and Berne. The authors attributed its origin to the fusion of glaciers at the period of their oscillations. 4. *Ancient alluvium*, with small rolled pebbles, not derived from the Alps, and bones of pachyderms, *Elephas primigenius*, *Rhinoceros tichorhinus*, *Bos priscus*, *Cervus euryceros*, *&c.* In Switzerland it rests on miocene molasse, and in Piedmont on marine pliocene beds. Northern Europe and America having been submerged at this period, many marine deposits were accumulated of the same age with these glacier formations.—*Proceedings of the British Association*, 1850.

GLACIAL PHENOMENA OF THE NEIGHBOURHOOD OF EDINBURGH. BY MR. R. CHAMBERS.

The author compares the Glacial Phenomena of Scotland with those of Sweden, with this difference, that in Scotland much of the surface has been masked, and many of the glacial maskings obliterated since the glacial epoch. The trap-districts near Edinburgh often form long and narrow hills, running east-north-east, some of them 800 feet high, and several of them presenting cliffs to the west, and long gentle declivities on the east. Mr. Chambers described the Corstorphine Hill as a stratum of trap dipping to the west, and with a cliff in a line north and south. In its crest, which raises to 470 feet above the sea, are three or four transverse clefts. On the west surface of the hill, the rock, wherever it is exposed, is found to be rounded *(moutonnée)*, smoothed, and grooved. The grooves, and the clefts in the crest of the hill, all lie in one direction, viz., directed to a point to the north of east. There are also, to the east of the hill, long hollows, with rounded intervening swells; and these run in precisely the same direction. At various places between the hill and the sea are seen sandstone surfaces, worn down to a remarkable flatness and smoothness; and in several instances marked with striæ, all pointing in the same direction. In Edinburgh itself, the north side of the Castle rock is smoothed and horizontally grooved, as if by ice passing along the hollow below. In forming the Queen's drive, on the south side of Arthur's Seat, the surface of the rock in the hollow between that hill and "Sampson's Ribs," was found to be wholly smoothed, polished, and furrowed and striated in the direction of the passage, which is easterly; on the north side of the same hill, the railway works have also laid bare a prominent mass of rock, polished and striated on its upper and western sides; other rounded and polished rocks occur up to a height of 400 feet. Throughout the Valley of the Forth, from the Pentlands on the one side to the Fife hills on the other, from Linlithgow to Dunbar, the sandstone surfaces, wherever they come up, are likewise smoothed, and in many instances striated in an east-north-east direction. The trap hills rising in this valley are all long and narrow, generally free from abruptness on the sides, often abraded on the west, and generally sloping away gently to the east; the direction here, also, is always to

E.N.E. Surfaces on the Pentlands and in Fife exhibit striation precisely conformable. In short, if a deep ice-flow passed through this valley, it might be expected to produce precisely the phenomena which have been observed. The similar markings in other districts of Scotland were shown for the most part, though not without striking exceptions, to be directed towards the east and south. Mr. Chambers adverted to the theory of debacles, which was started to account for the appearances, as now nearly given up. Ice was generally acknowledged as concerned in producing them, because the appearances were precisely those which the existing glaciers produce. But there was great room for speculation as to the circumstances under which the presumed glacial agent was applied. Mr. Chambers declined theorizing on the subject, but pointed out various conditions which any theory on the subject must explain. (1.) How ice could move over so large a portion of the North American continent, in a direction admitted to be tolerably uniform, allowing for slight deviations, easily explicable, as owing to inequalities in the original surface, and this without any mountain chain to give it forth. (2.) How this ice was capable of ascending slopes and topping mountains of considerable height. (3.) How, in such a valley as that of the Forth, there could be an ice-torrent of undeviating flow for many miles, and deep enough to envelope hills many hundred feet high.—*Proceedings of the British Association*, 1850: *Athenæum*, No. 1189.

EFFECTS OF RIVER ACTION.—RAISED SEA-MARGINS.

Prof. Hitchcock, of North America, has read to the British Association a paper "On the Effects of River Action in wearing down Strata, and on the raised Sea-margins of New England." The Professor took a general view of the effects of river action as contrasted with the waters of the ocean in eroding the terraqueous surface, and pointed out the various kinds of action as illustrated by the rivers of America, as well as those of other parts of the world. His general conclusions were, that the hollowing out of river channels, as well as that of valleys through which they flowed, was in a considerable degree owing to the eroding effects of their waters; and that the time required for their erosion was in the ratio of the hardness of the rocks over which they flowed. He was of opinion, too, that the various kinds of terraces, and the so-called sea-margins, might be accounted for by the gradual operations of rivers and the ocean, without having recourse to the supposition of our sudden catastrophes.

TERTIARY FOSSILIFEROUS DEPOSIT UNDERLYING TRAP IN THE ISLE OF MULL.

This interesting discovery has beeen communicated to the British Association by the Duke of Argyll. The island of Mull, according to Prof. Jameson, consists chiefly of trap, granite, gneiss, and mica slate, all of which are seen in the small bay near Ardtun, and at this

place are some small layers of brown coal interstratified with columnar trap. A little north of the bay is Ardtun Head, a perpendicular cliff of 130 feet, intersected by a deep fissure or ravine, accessible from the moor above. The cliff, the Duke remarked, consists of the following horizontal beds:—1. At the top, 20 or 30 feet of rudely columnar trap; 2. A thin laminated stratum containing fossil leaves; 3. Volcanic ashes; 4. A second leaf-bed; 5. A second bed of volcanic ashes; 6. A third leaf-bed; 7. Amorphous trap; 8. Columnar trap, occupying the base of the cliff. The volcanic ash-beds are undistinguishable from some modern formations at Vesuvius, and from the tuff at Madeira and Auvergne. The second leaf-bed is $1\frac{1}{2}$ to 2 feet thick, and in its lower part is a mere mass of vegetation. In the third bed the leaves are less numerous, and imbedded in a volcanic mud, which now forms a hard trap; the leaves are black and look charred, but this is not necessarily the case: no trunks, holes, or even small twigs were found. From these appearances the Duke concluded that the leaves had accumulated from autumn to autumn in a shallow lake, and had been overflowed by soft mud, in which they were preserved. The only indication of living animals found with the leaves was the track of a worm. Chalk flints were found entangled in the trap. The Duke also mentioned that the first recorded visit to this spot was paid by Dr. Johnson in 1773. In 1790, Mr. Mills (*Phil. Trans.*) visited the ravine, but did not notice the leaf-beds; and subsequently Professor Jameson and Dr. Macculloch had coasted the island and described its general geognosy.

Professor Edward Forbes stated that the leaves were in a very beautiful state of preservation, and belonged to species of plane, alder, pine, equisetum, and some others. From the presence of flints, the deposit appearad to be newer than the chalk, whilst in the latest tertiaries only vegetable remains of a more boreal character were found. The leaves most resembled some eocene specimens from Styria, figured by Dr. Unger, and those found in the (eocene) pipe-clay beds of the Isle of Wight. Sir John Richardson had also discovered leaves of similar character at Mackenzie River, in Arctic America. Fossil leaves and brown coal occur with layers of trap in Iceland, an island composed chiefly of trap and tertiary rocks. Professor Oldham mentioned the occurrence of similar fossil vegetable remains associated with trap in Ireland; but the merit of proving the tertiary nature of the brown coal in the Island of Mull is due to the Duke of Argyll.—*Jameson's Journal*, No. 98.

CHAT MOSS.

A PAPER has been read to the meeting of the British Association at Edinburgh, "On the Gradual Subsidence of a Portion of the Surface of Chat Moss in Lancashire by Drainage," by Mr. G. W. Ormerod. This was the continuation of a paper read at the Swansea meeting.* It was shown by a series of levellings made in the last four years,

* Reported in *Year-book of Facts*, 1849, p. 224.

over an extent of about two hundred acres, where drainage was carried on, that a subsidence had taken place to the amount of one foot per annum.

COAL IN ERZEROUM.

In the *Journal des Débats* an extensive bed of Coal is stated to have been discovered in the neighbourhood of Erzeroum, which province has hitherto been without combustible materials, and where the only fuel of the poor is the dried dung of the cattle. The country, though very productive, is excessively cold, and the thermometer descends as low as 25° below zero. The importance of this discovery may be, therefore, readily appreciated, and is probably but the prelude to other and more valuable ones; for foreign scientific men have already explored the mountains of that part of Turkey, and have positively stated that the soil, bearing an analogy to that of the Altai, in the north of Russia, should contain mines of gold and silver.

A MOUNTAIN OF QUICK-LIME.

A MOST important discovery has been made at Applecross, on the west coast of Scotland. A large mountain, called "Tore More," on being accidentally excavated, presented a substratum of pure Lime, within five feet of the surface; and on prosecuting the discovery by a further excavation, it was ascertained beyond a shadow of doubt that the whole mountain, except an average surface of twenty feet, consists of lime fit for the field or the mason, the result of organic heat. The hill appears to have been at one time a stupendous limestone rock, submitted to the influence of immense heat. On the summit are found traces of volcanic origin, such as charred and vitrified stone, lava, &c.—*Times.*

THE FALLS OF NIAGARA.

IF we follow the chasm cut by the Niagara river, down to Lake Ontario, we have a succession of strata coming to the surface of various character and formation. These strata dip south-west or towards the Falls; so that, in their progress to their present position, the Falls have had a bed of very various consistency. Some of these strata, as the shales and medina sand-stone, are very soft, and, when they formed the edge of the Fall, it probably had the character of rapids; but, wherever it comes to an edge of hard rock, with softer rock-beds below, the softer beds, crumbling away, leave a shelf projecting above, and then the fall is perpendicular. Such is the case at present: the hard Niagara lime-stone overhangs in *tables* the soft shales underneath, which at last are worn away to such an extent as to undermine the superincumbent rocks. Such was also the case at Queenston, where the Clinton group formed the edge, with the medina sand-stone below. This process has continued from the time when the Niagara fell directly into Lake Ontario to the present time, and will continue so long as there are soft beds

underneath hard ones; but, from the inclination of the strata, this will not always be the case. A time will come when the rock below will also be hard. Then, probably, the Falls will be nearly stationary, and may lose much of their beauty from the wearing away of the edge rendering it an inclined plane. I do not think the waters of Lake Erie will ever fall into Lake Ontario without any intermediate cascade. The Niagara shales are so extensive that possibly, at some future time, the river below the cascade may be enlarged into a lake, and thus the force of the falling water diminished; but the whole process is so slow that no accurate calculations can be made. The Falls were probably larger, and stationary for a longer time, at the "Whirlpool" than anywhere else. At that point there was no division of the cataract, but at the "Devil's Hole" there are indications of a lateral fall, probably similar to what is now called the American Fall. At the Whirlpool, the rocks are still united beneath the water, showing that they were once continuous above its surface also.—*Agassiz on Lake Superior*, p. 15.

A letter from Clifton House, Niagara Falls, dated June 29, 9 P.M. states:—About half-past 1 o'clock this afternoon, the large mass of rock known as Table Rock gave way, and went tumbling into the river below. The mass carried away was about six rods in width and twelve in length, and fortunately no one was injured. Not ten minutes before the occurrence a party of some twenty or thirty were standing on the rock, but happily had just left.

A later account says:—The portion that fell was from 150 to 200 feet long, and from 40 to 70 feet broad, making an irregular semicircle, the general conformation of which is probably well remembered by those who have been on the spot. It was the favourite spot for observation. The noise occasioned by the crash was heard at the distance of three miles, though many in the village on the American side heard nothing of it.

FIRST GEOLOGICAL APPEARANCE OF CONIFERÆ.

CONIFERÆ (Pine family), are remarkable for the apparently whorled arrangement of their branches, and for their evergreen leaves: in most cases they form hard *cones*, but one has soft, berry-like fruit. The seeds are naked, winged, resting on the scales. The leaves are peculiar, the nerves not being spread, but often gathered into compact bundles. The Coniferæ existed at a very early geological epoch. This was the first family that became numerous after the ferns. Their remains are easily recognised under the microscope by the circular disks on their wood-cells.—*Jameson's Journal*, No. 98.

DISTRIBUTION OF GOLD.

SIR R. I. MURCHISON, in a paper read to the Royal Institution, "On the Distribution of Gold in the crust and on the surface of the earth," has successfully dwelt upon Russia and Siberia as exhibiting on the grandest scale, proofs of the truths of his axiom, that gold

ore never occurred in any notable quantity, except under certain conditions, which (employing a useful term suggested by Mr. Babbage), Sir R. calls "constants." Throughout Russia in Europe, the crust of the earth being unbroken, and no igneous rocks having protruded, the strata are little solidified, and are everywhere devoid of metallic ores; but in the Ural Mountains the same old deposits, Silurian, Devonian, and carboniferous, being penetrated by eruptive matter, are metamorphosed, crystallized, veined, and in a highly metalliferous state; particularly on their eastern flank, where eruptive rocks most abound, including syenitic granite, porphyry, greenstone, serpentine, &c. It was next shown, that *gold occurs in quantity only in the upper part of veinstones;* and that when the latter are worked downwards, they become gradually much less auriferous, in which respect they differ essentially from argentiferous and all other metalliferous veins. This more or less superficial development of gold, the peculiar qualities of the metal itself, and of the hard quartz veins in which it is chiefly distributed, explain why the greater portion of gold is and must be found in those loose materials of gravel, shingle and sand, which cover the surface of the earth, and have resulted from *the grinding down of the tops of former mountains.* Besides positive proofs derived from shafts sunk into the solid rock, the diminution of gold in the deeper parts of the veinstones was also inferred from the fact, that all the great lumps or "pepites" of the metal have alone been found in loose gravel or sand, and never in the solid rock. A drawing of the enormous specimen, weighing 96 lb. troy, now in the Museum at St. Petersburgh, was exhibited. This huge mass was found loose in the bottom of a gravel pit lying on the surface of the rock. This auriferous gravel is in no way to be confounded with detritus formed by present atmospheric action, but is the result of ancient powerful abrasion of the surface of the rocks, particularly when mammoths and other great extinct animals were destroyed. This view was familiarly illustrated by stating that, if instead of being composed of chalk and flints, the Hertfordshire and Surrey hills had been crystalline, palæozoic, and eruptive rocks, the gravel of Hampstead and Hyde Park would be the gold-finding ground of the metropolis, whilst the Thames and its mud would only be auriferous where the river derived small portions of gold from its ancient banks. The vast preponderance of gold detritus in the northern hemisphere, and the large proportion of it in Siberia, leads to the surmise that with the persistence of the same rocks into Russian America the same results might be expected to follow; but as in Asia and in other countries, in special and limited tracts only. In stating that the same geological conditions prevailed in the Rocky Mountains, and their parallels throughout North and South America, Sir Roderick explained how closely the Sierra-Nevada of California agreed in mineral structure with the auriferous rocks of Siberia, and how, as far as the new El Dorado had been laid open, the auriferous detritus on the upper affluents of the Sacramento had proved richer than any similarly constituted tract; but

he especially cautioned his auditors against the popular delusion that all the surrounding region throughout several degrees of latitude and longitude was likely to prove equally productive.

A striking illustration of the law, that gold veins prove less and less auriferous downward, is seen in the mine of Guadalupe y Calno, at Mexico, where vein-stones, at first productive in gold, gradually became poorer, and in the deep shafts were exclusively argentiferous. Such, indeed, had been the loss attending deep gold-mining, that it had passed into a proverb with the Spaniards. On the other hand, the auriferous gravel and sand of the Brazils and Chili have long afforded good and profitable results. In alluding to our Colonies, Sir Roderick adverted to his own opinion, as publicly expressed some years ago, that, considering the nature of the rocks composing the frame-work of Australia, as described by Count Strzelecki, gold would be found to prevail in certain portions of that great continent. Such has proved to be the case, and Sir Roderick has received specimens of the metal in quartz rock, from the Blue Mountain, north of Sydney. In the ridges north of Adelaide, where so much fine copper has been worked out, gold also has recently been pretty plentifully discovered in the detritus and gravel, over upwards of 300 square miles, particularly by Mr. John Phillips, an enterprising Cornish miner.

The statistical portion of this vast subject was incidentally touched upon: California had produced little more than one million and a half sterling per annum, notwithstanding the exertions of a most spirited and adventurous people. It was also stated as a very general rule in mining, that the richer a vein is, the less is it likely that the ore will be diffused throughout a large mass of rock; and this was assigned as another reason for the inference, that in California, as in other parts of America, the great per-centage of gold will be confined to a few spots only. Russia had of late years exceeded three millions and a half sterling per annum, which was more than the half of the whole produce of the world. As even this great Siberian increase, which came suddenly upon us a few years ago, has produced no sensible change in the relative value of gold; so it was inferred that the extra production of a peculiarly rich spot or two of gold *surface-stuff* in North America, valuable as it now really is, was not at all likely to interfere with standards of value fixed after the experience of so many ages; for the shower of gold found at particular spots upon the surface must all be exhausted in a given and probably no distant time; whilst silver mines in the solid rock would seem to have scarcely any known limits to their productive capacity when the superior science of man becomes fully applied to them.

In conclusion, Sir Roderick repeated that it is essentially from the broken materials of the tops of the older and crystalline rocks of both the Old and New World that *all great quantities of gold* have been derived; and he specially adverted to the vast difficulties which man would have to encounter in the extraction and separation

of the precious metal, if it had not been providentially spread out for his use in great heaps, resulting from powerful attrition under water in former ages.

Specimens of gold ore from various parts of the world were exhibited, including many from California; among which was a fine lump with quartz rock acquired by the Right Hon. Edward Ellice about thirty years ago. The illustrative specimens furnished for the occasion by Mr. Tennant were also commented on.

SURFACE GOLD.

At the late Meeting of the American Association for the Advancement of Science, the following statement, made by Professors Rogers and Johnson, has its value from its practical importance. They took occasion to call attention to the fact, that the anticipations excited by the discovery of gold on the surface are seldom fully realized. At the surface, meteoric influences have, in most cases, been at work, and have effected such a decomposition and segregation that there the gold is easily obtained; but as we proceed lower down, beyond the influence of the air, we find the gold so closely connected with other minerals that its separation is a very difficult process, only effected after much expense and labour. In explanation of these views, it was stated that at Gold Hill the toll at the mill for grinding is, for surface ore, 20 cents,—for that obtained lower down, 30 cents the bushel. It is found, however, that if, after the ore has once been operated on, and all the gold possible extracted, it is exposed for a few months to atmospheric influences, you can then obtain as much gold from a bushel of ore as at first.

GOLD FROM CALIFORNIA.

Mr. Walls has exhibited to the Society of Arts, a lump of Gold from California, weighing almost 7 pounds. At the same time were exhibited some specimens by Mr. Tennant, who stated that Mr. Walls's lump was evidently a water-worn fragment. The gold is usually found in small grains, which are obtained by washing the alluvial soil. He also exhibited a specimen of gold which, at the time he had purchased it (about two months before), was the finest specimen of pure native gold he had seen: it contained 92 per cent. of pure metal. It had attached to it some of the alluvial soil, in which it was supposed that one or two small diamonds might be detected. Mr. Tennant was anxious to decide this point, as he had stated to the Society of Arts, in 1849, that diamonds and other precious stones might be found in the gold districts of California; and that such gems are being thrown aside, although the refuse diamonds sold to the lapidary to be broken up are worth £50 per ounce, while gold is not worth more than £31. 15s. He had not, however, been able to discover any diamond; but, on examining the soil with a microscope, he had detected some small crystals of garnet, two grains of platinum, and several of quartz, &c. In looking over a quantity of other specimens he had found quartz in

great abundance, and it had evidently formed the original matrix of the gold. He next called attention to the fact, that gold is not generally found in the position in which it was originally deposited.*

GOLD FROM JAMAICA.

A LARGE lump of auriferous rock or stone has been received from the neighbourhood of Annatto Bay, Jamaica. Split open, it appears almost one compact mass of gold and silver, the pure silver ore lying in small lumps thickly interspersed with gold particles. This lump will yield about 70 per cent. of the precious metals. This is considerably richer than many of the Californian specimens. —*Standard.*

GOLD IN WICKLOW.

MR. W. MALLET has examined the Native Gold found in the beds of some of the Wicklow streams, and finds the mineral here in its most beautiful form. It possesses the true golden colour and metallic lustre which characterize the metal, and, owing to the attrition to which it has been subjected, generally presents a beautifully brilliant surface. It occurs in grains of all sizes, from the smallest spangle up to a mass weighing twenty-two ounces, the largest hitherto found. The specific gravity of some small grains Mr. Mallet found to be 16.342. The analysis of these grains gave—gold, 92.32; silver, 6.17; iron, .78; total, 99.27. This is equivalent (neglecting the iron) to $8\frac{1}{4}$ atoms of gold and 1 of silver.—See *Philosophical Magazine*, No. 249.

SILVER LODE IN DEVON.

A VERY valuable Silver Lode has been discovered on Ell Bridge Estate, the property of Mr. W. Wymond, in the parish of Landulph, about four miles from Saltash, on the direct Callington road. Applications have been repeatedly made for the last twenty years for a grant of the sett; which, however, could not be obtained till about a fortnight since, the proprietor not believing his estate contained any mineral, and supposing that his land would be broken up to no purpose. Operations were lately commenced, and when only three feet from the surface, a valuable lode of silver-lead ore was opened on, showing that the opinions of the practical miners were correct. The ore taken from it, having been carefully assayed, produced 10 in 20 for lead, and 200 ounces of silver in the ton of ore. The

* In the *Pacific News* has appeared the following miraculous report of a party of emigrant gold-seekers, who pushed on about 230 miles from the Pueblo:—"Here among the eastern spurs of the Sierra Nevada, they found gold and silver too, in such quantities as they had not dreamt of—a perfect mountain of rocks with silver and gold mingled, and commingled in solid masses, weighing from one to many tons. The quartz proved to be exceedingly hard, to such a degree, that during their short stay, all the implements made for this particular purpose before starting were completely worn out in the operation of drilling and blasting. The strangest part of the whole discovery is yet to be told. These large boulders of gold, silver, and quartz have the gold in the south end, and the silver in the north end. No exceptions were found in their examinations, the silver being the more abundant of the two."

shaft has since been sunk about four fathoms, where the lode is four feet big, and the ore found to be of much greater richness. This is one of the richest lodes ever seen in this locality so near the surface. —*Plymouth Guardian*.

ON INFUSORIAL DEPOSITS ON THE RIVER CHUTES IN OREGON. BY M. EHRENBERG.

Ehrenberg first draws attention to the results of his former researches, that the Rocky Mountains are a more powerful barrier between the two sides of America, than the Pacific Ocean between America and China; the infusorial forms of Oregon and California being wholly different from those on the east side of the mountains, while they are partly identical with Siberian species. This fact is confirmed by his examinations of the earth from the gold region of California, and from the Chutes river of Oregon, obtained by Fremont. The latter deposit is situated at an elevation of 700 to 800 feet, and constitutes a bed 500 feet thick of porcelain clay. It is overlaid by a layer of basalt 100 feet thick.

Professor Bailey, who examined this material for Fremont, reported that it consisted of fresh-water infusoria; and many species were distinguished. Ehrenberg, on farther investigation, has made out seventy-two species of Polygastrica with siliceous shells, sixteen species of Phytolithuriens, and three of crystalline forms. The more prevalent species are *Discoplea oregonica*, *Gallionella granulata*, *G. crenata*, *Eunotia Westermanni*, *Cocconema asperum*, &c. The *Discoplea* and *Raphoneis oregonica* are the only two species characteristic of the locality. The beds are more recent than those of the Klakamus river, a few miles from the Falls of the Willammet.—(*American Journal of Science and Arts*, vol. ix., No. 25, Second Series.)

THE DINORNIS.

Professor Owen has read to the Zoological Society a paper "On Dinornis: Part V., on the Cranium of the large species called Giganteus and Ingens.' * He commenced by referring to a former memoir, in which four generic types of structure had been determined in fossil crania of birds from New Zealand,—viz. Nestor, Notornis, Palapteryx, and Dinornis proper; and proceeded to describe an additional series of fossil skulls obtained by Governor Sir George Grey from a cave in the district which lies between the River Waikato and Mount Tongariro, in the North Island. The most remarkable of these specimens was an almost entire skull, measuring eight inches in length and five inches across the broadest part of the cranium; which in the extent of the ossified part of the mandible and its downward curvature resembled the smaller skull described in a former memoir, and there referred to Dinornis. In the structure of the occiput and base of the cranium this large skull more resembled the characters of that ascribed to Palapteryx. The indications of the muscular attachments, and the form and size of the massive beak, bespoke the great power and force with which it had

* For No. IV. see page 238 of the present volume.

been habitually applied in the living bird. Its anatomical characters were minutely detailed. Comparisons of the area of the occipital foramen for the transmission of the spinal marrow with that of the spinal canal in different vertebræ were made, with a view of determining the species to which the cranium in question might belong; and the peculiar contraction of the spinal canal in the vertebræ of Dinornis, as compared with that in the ostrich, was pointed out. The inference deduced was, that the cranium, notwithstanding its great size, belonged probably to the species called *Palapteryx ingens*, which was the second in point of size. A mutilated cranium of a much younger bird, showing all the sutures, but of nearly equal size with the skull first described, might belong to the *Dinornis giganteus.* Two crania referable to two distinct species of smaller birds of Palapteryx were described, and sections of the cranium were shown to demonstrate the form and character of the brain. In the collection transmitted by Governor Grey, Prof. Owen had, for the first time, recognized a portion of a diminutive wing-bone, similar, in the absence of the usual processes for the muscles of flight, to that in the Apteryx, and confirmatory both by this character and its extreme rarity, contrasted with the abundance of vertebræ and leg-bones that had been transmitted, of the inference as to the rudimental condition of the wings in the Dinornis and Palapteryx. The memoir concluded with a description of a cranium of the Notornis, more perfect than that fragmentary one on which the affinities of that bird to the Rallidæ or Coot tribe had originally been founded, and its generic distinction from Porphyrio established. The specimen exhibited confirmed the accuracy of the conjectural restorations in the figure of the original specimen in a former volume of the "Transactions of the Zoological Society."

FOSSIL CROCODILIA OF ENGLAND.

Our fossil evidences supply us with ample materials for a most strange picture of the animal life of ancient Britain, and what adds to the singularity and interest of the restored *tableau vivant*, is the fact, that it could not now be pre- sented in any part of the world. The same forms of crocodilian reptile, it is true, still exist, but the habitats of the Gavial and the Alligator are wide asunder, thousands of miles of land and ocean intervening: one is peculiar to the tropical rivers of continental Asia, the other is restricted to the warmer latitudes of North and South America; both forms are excluded from Africa, in the rivers of which continent true crocodiles alone are found. Not one representative of the crocodilian order naturally exists in any part of Europe; yet every form of the order once flourished in close proximity to each other in a territory which now forms part of England.—*Professor Owen's History of British Fossil Reptiles*, Part iii.

THE MASTODON.

There has been read to the Geological Society, a "Notice of the Discovery of a nearly perfect Skeleton of the *Mastodon angustidens*,

near Asti, in Piedmont," in a letter to Sir R. I. Murchison, from Prof. Eugene Sismonda. These remains occurred about six leagues from Turin, in a bed of plastic clay containing freshwater shells, and covered with sand. Many of the bones were much decayed; but the skeleton, preserved in the Royal Museum of Turin, is perhaps the most perfect hitherto found in Europe.

VESUVIUS.

The Naples Correspondent of the *Athenæum*, No. 1175, May 4, writes:—"A recent visit to Vesuvius enables me to give you a precise account of its present state and form. The old cone is almost broken up, and has assumed a new shape. To give even a faint idea of it to those who have not visited the mountains, I must enter into some details as to its former appearance. Previously to the last eruption, the cone rose from the centre of the mountain; forming,—if I may be allowed so to express it,—a valley separating its inner or main cone, and rising to the height of some 60 or 70 feet. This inner cone was exceedingly difficult to ascend; being composed of loose ashes, which gave way at every step. The apex might have been about three miles in circumference, having a descent within of about 100 feet, which persons could accomplish with slight difficulty; and perhaps there were 200 feet more thence to the bottom. In February, the eruption took place on the S.E. side of this cone; breaking out in the so-termed valley, and extending into the wall of the cone,—at the same time by its action destroying the outer cone to a considerable extent. The apex of the new cone is irregular, and about two miles in circumference, having on the walls beautifully variegated lines of green, yellow, orange, and brown: and judging from the time which intervenes between the heavings, the gaspings of the mountains, or the volumes of steam emitted, calculating by the minute hand, the depth cannot be greater than 300 feet. On its northern side a mound has been thrown up, rising to the height of 40 feet. The old cone on its S.E. side is nearly levelled with the original valley, and the other parts of the wall have decreased in height irregularly and gradually to the point which joins the newly-formed cone. The descent is now easily gained, and does not exceed 150 feet."

EARTHQUAKE IN ANATOLIA.

On the night of the 19th of April, 1850, at half-past eleven, P.M., a shock of considerable violence occurred at Brussa, Anatolia, lasting from eight to ten seconds. The oscillation seemed to proceed from south or south-west. This was followed by two other shocks during the night, and by four others at intervals up to the 21st, all comparatively slight. The same Earthquakes were felt throughout the country as far as Kiutahiyah, particularly at Muhalitsch, at Lubat, on the Lake Apollonia, and at Kirmasli, on the south side of the lake; at which latter place there was a temporary gush of water and sand from an opening in the earth. It was noticed that the

strongest shocks followed shortly after heavy storms of hail; and also that at Tehekerghe a momentary stoppage of the mineral streams accompanied the earthquake.—*Communicated to the Geological Society.*

GEOLOGICAL SURVEY.

We find the following Report of the progress of the Geological Survey of the United Kingdom (signed by Sir H. De la Beche) in the Parliamentary Papers on the Estimates in Connection with Science and Education. "This service has considerably advanced during the year. Denbighshire, which includes the continuation of the Oswestry and Wrexham coal field, is completed. The examination of Carnarvonshire is terminated, with the exception of a small portion of the mountain district, the early snows on which prevented its final survey. The island of Anglesey, including its mines, is nearly finished. Flintshire, with its coal field and extensive metalliferous districts, together with the western portion of Cheshire, is surveyed. The Staffordshire coal field, with its adjoining country, is very far advanced. Dorsetshire is very nearly completed, and a large part of Hampshire has been examined. The maps of these districts, and others ready towards the close of last year, the whole closing an area of about 5,350 square miles, are now in course of publication, and will shortly be accompanied by numerous illustrative sections. In Ireland, the counties of Carlow and Kildare have been completed, and maps of them published. The county of Dublin has been surveyed, and the map of it is now in the hands of the engraver. The examination of the county of Wexford is nearly finished, and will shortly be ready for publication. The collection of soils and subsoils of the country surveyed, accompanied by information regarding them, has progressed as heretofore, and 194 specimens from different localities have been forwarded to the Museum of Irish Industry, Dublin, for analysis. In connection with the Geological Survey of the United Kingdom, the organic remains obtained during its progress have been extensively examined and classified for public inspection, and about 23,200 specimens have been thus treated during the year. Numerous donations have been received from geologists desirous of promoting the progress of the Survey. Whole collections have been thus presented: such as a series of Devonian fossils, by Mr. R. A. C. Austen; of organic remains from Folkestone, by Mr. C. Clarke; from the chalk and London clay, by Mr. Wetherell; from the Isle of Man, by the Rev. J. Cumming; and from various parts of the kingdom, by Mr. Weaver. Two decades of figures of selected fossils, with their descriptions, have been published, and others are nearly ready."—*Athenæum.*

Astronomical and Meteorological Phenomena.

SPLENDID METEOR.

On the night of February 11th, 1850, a magnificent Meteor was seen all over England; and its appearance recorded by many observers. Forty-five accounts have been communicated to the *Philosophical Magazine*, Nos. 242 and 243, by Mr. James Glaisher, F.R.S., of the Royal Observatory, Greenwich. From these we select the following:—

Royal Observatory, Greenwich. The following observations were made by the Astronomer-Royal:—

On the night of Monday, February 11th, I was standing in the Computing Room, at a distance of about 4 feet 6 inches from the western wall of the room, and 3 feet 4 inches from the pier between the central and western windows on the north side of the room, with my eyes glancing downwards to some papers on the table (I think my lamp was in the window-seat of the west window), when my attention was attracted to a general light of strong yellow colour upon that part of the sky which was seen through the western window. I raised my eyes and saw the sky most fully illuminated; the form of the north-east dome and the walls near it (which had been invisible before and were totally invisible afterwards, from the room, while my lamp was in it) were brought out not only distinctly but conspicuously, I think as well as if a large moon had been behind the dome; but the colour of the light was so different as to make comparison difficult. In an instant there came in the direction from W.S.W. to E.N.E a brilliant body like a Congreve rocket, followed by two others close behind it (I cannot assert that there were not more than two) in the same path. The direction of their path was nearly horizontal, but slightly rising, I think. The height above the top of the dome was nearly equal to the semidiameter of the dome, I think rather less.

I think that the meteor passed my field at the western window in less than $1^s \cdot 5$; and I saw nothing of it at the central window. All was very thickly dark as before. My first impression was that it was a recket; on a moment's consideration I saw that it was impossible that a rocket could have such a nearly horizontal course except fired from the leads of my own house. I then looked at my watch, and, allowing as well as I could for the few seconds past, the watch time was $10^h\ 42^m\ 10^s$. By a comparison with the ball clock made immediately afterwards, the watch was 42^s fast on Greenwich mean solar time.

On going into the open air, I found that that part of the sky, and the north generally to the height of 30° or 40, was starlight, and that there were stairs visible over head, but the south was clouded.

From careful measurements afterwards, and calculation, its elevation at this part of its path was nearly 14° 53′, and its azimuth 19° west of north.

From Hull, by William Lawton, Esq.

"The meteor appeared at 20 minutes to eleven o'clock; and when I first saw it (which was not at the moment of its first appearance), it was 5° N.E. of Sirius, advancing to the E.S·E. in the direction of the stars ξ and 15 Argûs, near which it exploded at an altitude of 12°, and at about 15° west of the meridian.

"Its light was intense and dazzling in the extreme, and created in my mind the impression of being a body in course of explosion throughout its whole course; its size seemed to be about half the diameter of the moon.

"I noted the time and its path immediately after its disappearance, and with all the care the circumstances would permit, with the view of enabling myself and others to ascertain the length of its path and distance from the earth at the time of bursting.

"I heard no report or noise of any kind. There was a slight tinge of blue in its light, which far exceeded that of the full moon."

The position of the meteor at the time of explosion, being near 15 Argûs, is well marked; at the time of observation the star was near the meridian,

and was 11° high at Hull; therefore 12°, as stated above, must be very near the truth.

From Rugby, by the Rev. H. Highton, M.A.:—

1. Time. The school clock struck $10^h\ 45^m$ immediately after the explosion was heard. I suspect it was a few minutes fast by Greenwich time.
2. The light quite obscured the gas-light. Some say they could have read the smallest print by it. Some compare it to a strong sun-light. All speak of its similarity to the electric light in colour and vividness.
3. Direction. From W. to E., at an angle of about 20° below the zenith, or 70° about the southern horizon. It exploded so soon after reaching the zenith, that the fragments are described as appearing to fall a few yards off.
4. Duration of the light, at least 50 seconds.
5. the explosion was like that of a rocket; and fragments are described as being seen falling, though *not luminous.*
6. The point of the explosion was nearly due S.E.* (reckoning the magnetic and not the true meridian), and at an angle of about 20° from the horizon; so that it must have been at a very considerable distance from Rugby.
7. The distance of time between the explosion and the detonation was at least 90 seconds, and probably between 90 seconds and 100 seconds.

The point of explosion was nearly due magnetic S.E; the south end of needle standing at 0°, the reading of the circle where it is cut by the line joining the eye; centre of compass and the point of explosion of meteor is 45° or 135° from the west end of needle. The points observed by three observers are so plain and well-defined, that there is no room for more than a few degrees of error.

Having detailed the several accounts received, Mr. Glaisher proceeds to discuss them, with the view of determining the distance, path, velocity, &c. of the Meteor. We have only space to quote Mr. Glaisher's conclusion:

"After the explosion, the luminous bodies were seen till they were within 10 miles of the earth. The report accompanying the explosion was so great, that I am inclined to believe that the substance of the meteor was of a firm texture, broken into many pieces by the extraordinary expansion of an elastic fluid; if so, its particles would fly off in all directions; some would describe parabolic curves, as mentioned by the Rev. C. J. Goodhart; some would continue to move with accelerated force in the same direction, and some would fall vertically. It seems probable that some parts of this body may have reached the ground within a few miles round Biggleswade. It seems certain that this meteor must have come from the regions of space far beyond the influence of our vapours; and this fact, together with its extreme velocity, and the intensity of the light, are circumstances more conformable to a solid than to a gaseous substance. The original accounts will be preserved in the Archives of the Royal Observatory, Greenwich."

AEROLITES.

A LETTER from Jerbah, dated Jan. 25, 1850, records, about two months previously, the Fall of a Shower of Aerolites, with a brilliant stream of light accompanying them, and which extended from Tunis to Tripoli, some of the stones falling in the latter city. The alarm was very great in Tunis, and several Jews and Moors imme-

* The variation of the compass at Rugby is 23° 15′; therefore the azimuth was 68° 15′ E. of S.

diately fled to the British Consulate, as the common refuge from every kind of evil and danger. The fall of these aerolites was followed by the severest or coldest winter which the inhabitants of Tunis and Tripoli have experienced for many years.

DESTRUCTIVE STORM IN DUBLIN.

The Rev. D. Lloyd has communicated to the Royal Irish Academy, some observations on a destructive Storm in Dublin, on April 18, 1850.

The first indications of the approach of the storm were observed soon after three o'clock P.M. Massive *cumuli* were seen forming in the south-western portion of the sky. About half-past three o'clock it burst forth. The flashes of lightning (generally forked) succeeded one another with rapidity, and at length the roar of the thunder seemed continuous. Some persons who observed the phenomenon from a distance were able to distinguish the two strata of oppositely electrical clouds, and to see the electrical discharges passing between them. Shortly before four o'clock the rain commenced; this was followed almost immediately by discharges of hail, and at four P.M. the terrific tornado, which was the grand and peculiar feature of this storm.

This gale, which appears to have been a true whirlwind, first sprang up from the S.E., driving the hail before it impetuously. It then suddenly, and apparently in an instant, shifted to the point of the compass diametrically opposite, and blew with increased violence from the N.W. The noise about this time of the shifting of the wind was terrific, and arose (as is conjectured respecting similar tropical phenomena) from the confused conflict of hail in the air. The size of the hailstones, as well as the vehemence of the gale, appeared to be greater during the second phase of the storm than in the first. These masses, many of which were as large as a pigeon's egg, were formed of a nucleus of snow or sleet, surrounded by transparent ice; and this again was succeeded by an opake white layer, followed by a second coating of ice: in some of them Dr. Lloyd counted five alternations. In less than ten minutes the tornado had passed. The wind returned to a gentle breeze from the S.W.; and the weather became beautiful.

A BLACK SHOWER.

A letter from Bulwick Rectory, Northampton. dated July 23, 1850, records a shower of hail, as large as marbles, and many of them the size of walnuts. On the day following St. Swithin, Tuesday, July 16th, a sort of rumbling, as of waggons, was heard for upwards of an hour without ceasing, in an easterly direction. On Friday, there fell a great shower of black rain, about three or four o'clock, rendering quite black clothes on the hedges and those spread on the grass to dry; also rendering water caught in tubs and vessels from the church leads, and from slated and tiled houses, almost the colour of ink. This black shower came down from one particular

cloud, for the rain in the morning was perfectly clear and fit for washing purposes; but the rain that fell between three and four o'clock was perfectly black, and caused a black-lead froth.

A SHIP SUNK BY A WATERSPOUT.

A FEARFUL accident has recently happened to the Maltese brig *Lady Flora*, which vessel left Malta on the 14th of October, for Leghorn. On the same day, about nine P.M., when about thirty miles to the west of Gozo, she was struck by a waterspout, and immediately foundered. One man alone was saved by the Maltese brig, which was near: but all endeavours to save more of the hapless crew were fruitless. About nine men, among whom were the owner of the ship and his son, thus met a watery grave.—*Maltese Correspondent of the Times.*

ON THE HAIL STORM OF MAY 5, 1850, AS OBSERVED AT THE KEW OBSERVATORY. BY MR. W. R. BIRT.

"AT half-past 5 in the afternoom, on May 5, 1850, my attention was arrested by a very heavy and dark collection of clouds (*cumuli*) in the N.E., from which rain was falling in the distance. The appearance of the clouds was very black and threatening. Below this black collection, which occupied a very considerable portion of the sky from the zenith to the eastern horizon, the cloud, apparently a sheet of *cirrostratus*, presented a most remarkable reddish hue. Cirrostratus had been prevalent during the day. At 9 A.M. I registered *cirrus*, *cirrostratus*, *cirrocumulus*, and *cumulus;* and at 3 P.M. *cirrostratus* and *cumulus*. On both occasions these clouds were moving from the *south-west*. At 3 P.M. I observed a very splendid solar halo; the portion of it not covered by cumuloid clouds was exceedingly well-defined, the angular distance between its upper portion, and the sun being 21° 49″. It continued more or less visible until 4 P.M., and presented an elliptical form, the lower portion being much further from the sun than the upper. The interior boundary of the halo exhibited a reddish-brown tint, gradually passing towards the exterior boundary into a softened white, which thinned off into the general mass of cloud; the *darkness* of the interior space, especially near the halo, was very striking. When I first noticed the threatening aspect of the clouds, those in the immediate neighbourhood of the observatory were moving from the S.W. At 5h. 40m. P.M. a few large drops of rain fell; they were almost immediately succeeded by hail (small), and hail mingled with heavy rain continued to fall until 6h. 10m. During this time the process of nimbification proceeded rapidly, extending from the N.E. towards the S.W.; so that although just previous to the commencement of the storm the clouds were moving in the opposite direction, the action, now very considerable, rapidly converted the cumuli hovering over the observatory, and more probably to some distance S.W. of it, into nimbi, accompanied with a very copious precipitation of hail. While this active pre-

cipitation of hail was proceeding, the electrical conductor became charged to about 40° of Henley's electrometer, the pendulum vibrating rapidly at the time when the hail came down in greatest abundance and of the largest size, and sparks were observed 0·3 inch in length.—*(Observatory Report.)*

"The heavy rain previously noticed ceased at 6h. 27m., and during the 47 minutes of this portion of the storm the temperature declined 4°·7. After this a lighter rain fell until 7h. 10., in the course of which the tension, as manifested by the conductor, increased: the vibrations of the pendulum of Henley's electrometer also increased: on one oecasion it reached 90°, with sparks 0·70 inch in length. During the storm the charge was generally negative."

We have in the above phenomena an illustration of Mr. Howard's remark * * * *:—"This rain opens an immediate communication with the earth; the positive electricity, which before rendered the particles buoyant, *streams down along with the rain and through it;* and the shower is propagated in all directions till the whole mass of cloud is brought into action." The great body of cloud, as appears from observations at the commencement and close of the storm, was moving from the S.W., from which the legitimate inference is, that the storm itself was moving from S.W. to N.E. When the black threatening appearance was first noticed in the N.E., rain was falling from the bases of the cumuli; it did not, however, appear to be of great extent; and at the same time the clouds in the S.W., W. and N. and N.W., presented, especially as contrasted with those in the N.E., a remarkably *light* appearance: the storm did not pass over this observatory from the S.W. Shortly after the rain commenced, and during the continuance of the hail, the well-defined black masses of cumuli were rapidly resolved into nimbi; and it appeared to the writer that this resolution of cumuli into nimbi occasioned the apparent progression of the storm from the N.E. Unfortunately, he did not particularly observe the character of the clouds in the S.W., W. and N.W.; but his impression is, that during the entire period of the storm the atmosphere was much *lighter* in those directions. It would be extremely interesting to learn at what point nimbification began, and how far it extended on each side the nucleus. The apparent conclusion from the phenomena is, that when nimbification commenced it rapidly extended in *all directions* from a central point.

The hail was not noticed either at Mortlake or Petersham, both near Richmond; the clouds were moving towards the former village, and the dark threatening appearance was seen in that direction; so that the nucleus was most probably between Richmond and Mortlake, but nearest the former place. The storm was observed at Ham.

USE OF COLURED GLASSES TO ASSIST THE VIEW IN FOGS.

M. Lavini, of Turin, in a letter to the editor of *L'Institut* at Paris,

makes the following curious observation, which, if confirmed, may prove to be of great importance:—"When there is a fog between two corresponding stations, so that the one station can with difficulty be seen from the other, if the observer pass a coloured glass between his eye and the eye-piece of his telescope, the effect of the fog is very sensibly diminished, so that frequently the signals from the other station can be very plainly perceived; when, without the coloured glass, even the station itself is invisible. The different colours do not all produce this effect in the same degree, the red seeming to be the best. Those who have good sight prefer the dark-red, while those who are short-sighted like the light-red better. The explanation of this effect seems to depend upon the fact, that the white colour of the fog strikes too powerfully upon the organ of sight, especially if the glass have a somewhat large field. But by the insertion of the coloured glass, the intensity of the light is much diminished by the interception of a part of the rays, and the observer's eye is less wearied, and, consequently, distinguishes better the outlines of the object observed."

STORM-GLASS.

THIS instrument consists of a glass tube, sealed at one end, and furnished with a brass cap at the other end, through which the air is admitted by a very small aperture. The tube is nearly filled with the following solution:—Camphor, ʒiiss.: nitrate of potash, gr. xxxviij.; muriate of ammonia, gr. xxxviij.; water, ʒix.; and rectified spirit, ʒxj. Dissolve with heat. At the ordinary temperature of the atmosphere, plumose crystals are formed. On the approach of stormy weather these crystals are often observed to occupy only the bottom of the tube, where they appear to be compressed into a compact mass; while, on the other hand, during the fine weather, they assume their plumose character, and extend a considerable way up the glass. These results depend upon the condition of the air, but they are not considered to afford any indication that can be relied upon of the approaching state of the weather. When exposed to a very low temperature, the compound camphor-liniment bottle affords the same appearance and indication as these storm-glasses.—*Pharmaceutical Journal.*

BRITISH METEOROLOGICAL SOCIETY.

WE have to notice the recent formation of a Society for the advancement of Meteorological knowledge, "a branch of physical inquiry which," as remarked in the published Address, "requires the combined efforts of numerous observers, steadily following a well-concerted plan, employing the same class of instruments, and reducing their results in the same form."

By facilitating a comparison of the observations of its own members with those made in other countries, meteorological phenomena will be better traced, and thus effects more satisfactorily and surely referred to their true causes. A remarkable instance of the want of

connecting observations has been so recently rendered obvious, that it may not be without its use briefly to refer to it here. In the "American Traveller," published at Boston on April 6, 1850, and recently received in this country, is a paper by W. Cranch Bond, Esq., of Cambridge, United States, in which he speaks of the great atmospheric wave which was passing over England from the 1st to the 18th day of February, 1849, the mean reading of the barometer during this interval of time being fully half an inch above its average value; and when the crest of the wave was over Greenwich, the reading of the barometer at the level of the sea was 30·90 inches. The base of the wave at this time seems to have been in extent just equal to the distance from England to America; for on the same day that it completed its passage at Greenwich, it was first felt at Boston, and it was seventeen days passing over Boston, as it was with us. Its motion, therefore, must have been about 170 miles daily. The reduced readings of the barometer during the time of the passage of the wave at Boston, and its extreme readings, were identical in value with those at Greenwich.* At present we cannot follow this very remarkable heaping up of the air from the want of observations at different places.

Another object of this Society will be to avail itself of every opportunity of establishing observatories in those parts of the world where none are at present in existence.

NEW PLANETS.†

Sir John Herschel, in a letter to the *Athenæum*, date May 27th, stated that he had received from M. de Gasparis, of the Royal Observatory of Naples, intelligence of his discovery, on the 12th inst., of another New Planet,—which he proposes to call Parthenope. It was near its opposition, and equal to a star of the seventh magnitude. Its situation in the heavens may be collected from the following data:—App. R.A. May 11th, $12^h\ 51^m\ 53{\cdot}1^s$ M.T. at Naples $= 230°\ 21'\ 53{\cdot}23''$; App. Decl. $= 10°\ 35'\ 12{\cdot}9''$ South.—May 12th, $11^h\ 42^m\ 2{\cdot}8^s$ App. R.A. $= 230°\ 8'\ 28{\cdot}63''$; App. Decl $= 10°\ 31'\ 58{\cdot}9''$ south.

The Academy of Sciences in Paris has awarded the Lalande Medal to M. de Gasparis, for his discovery of the planet Hygeia, in April 1849:—and shared its astronomical prize for 1850 between the same gentleman for his discovery, in November, of two planets—Parthenope and another yet unnamed;—and Mr. Hind, for his discovery, on the 13th of September, of the planet Victoria.

On December 8th, communications were read to the Astronomical Society, relative to the New Planets Egeria and Victoria. The former was discovered by Prof. Annibale de Gasparis on the evening of the 2nd of November of the year 1850, about $6^h\ 50^m$ p.m. whilst

* Incidentally noticed at page 136.

† We recorded with pleasure the appointment of Sir John Hersehel to the office of Master of the Mint, with active and responsible duties attached, and a salary of £1500 a year; the office to which Sir Isaac Newton was appointed in 1693.

working at his zones near the ecliptic, the precise object of which is to find new planets. Mr. Hind writes :—" About 10 o'clock on the evening of September 13th, I discovered a new planet in the constellation Pegasus. I was occupied at the time in a close comparison of a chart for Hour xxiii. with the heavens ; re-examining the small stars inserted in previous years to insure their being placed in a right position on the map, and to ascertain if any change of magnitude had taken place : for it has always appeared to me very desirable that every variable star should be duly specified in forming a chart. Near one of the 10th magnitude, entered in 1848, I found another brighter object, which was at once suspected to be a planet, as it could hardly have escaped my previous sweeps over the vicinity." In the course of an hour and thirty-four minutes, the difference of right ascension between the suspected planet and the star of the the 10th magnitude, was found to have increased from $14^{s}\cdot45$ to $27^{s}\cdot95$, and an intermediate observation showed a proportionate rate of increase which could leave no doubt as to the planetary nature of the interesting stranger.

Communications have been made relative to Parthenope, Metis, Flora and Neptune :—which last was observed a third time and regarded as a fixed star of the 9th magnitude, by Dr. Lamont, at Munich, on the 7th of September, 1846, having been previously observed by the same astronomer, on the 7th of the same month, as well as on the 1st of October, 1845. Mr. Hind remarks :—" A notice of this additional observation is interesting as showing that *an immediate reduction* of the zones of the 7th and 11th of September could not have failed to point out the planet ; and the discovery might have been effected prior to the 23rd of September, when it was recognized by Dr. Galle."—*Athenæum*, No. 1209.

NEW COMET.

Towards the close of June, and the commencement of July, a Comet discovered by Dr. Petersen, at Altona, on the 1st of May, was visible to the naked eye in the constellation Bootes. With an ordinary night-glass the tail might be traced to a distance of about two degrees from the head, which is bright ; and, without the telescope, resembles a star of the fifth magnitude. On July the 6th, it was situate two degrees west of 16 Bootis ; on the 7th a little above a line joining the star Rho in the belt, with the well-known star, Cor Caroli, and about one-third of the distance between those stars from Rho. Next evening a line from Rho Bootis to 41 Coma Berenicis passed close to the comet, which was nearer to the former star. On the 9th it was two degrees east and a little north of the star numbered 9 in Bootis, and in a line joining it with Rho, of the same constellation ; on the 11th, about one degree north of 10 Bootis, below a line from Arcturus to Cor Caroli, 5 degrees from the former star. Next evening the star was on the parallel of Arcturus, near Eta Bootis ; on the 13th situate between Eta and Upsilon, a little east of a line joining them ; and on the 14th, nearest to the

earth, and in a line with Upsilon Bootis and Tau in Virgo, a degree or more south of the former star. The comet passed the equator on the 19th, two degrees east of Zeta Virginis, and arrived at its least distance from the sun about midnight on July the 23rd in Right Ascension 11^h 27^m, and 10° south declination.—*Times*.

A telescopic comet was discovered by Mr. Bond, at the Observatory of Cambridge, near Boston, U.S. on the 29th of last August, and independently by Mr. Brorsen, of Senftenburg, in Bavaria, by M. Mauvais, at Paris, and Mr. Robertson, at Markree, and by Dr. Clausen at the Observatory of Dorpat, on the 5th, 9th, and 14th of September respectively. This comet was observed by American astronomers till the end of October; and although its discoverer, Mr. Bond, has detected six or seven others, this is the first which bears his name, as in all the other instances a prior discovery was recognized.

THE ANNUAL VISITATION OF THE ROYAL OBSERVATORY.

The Annual Visitation of the Royal Observatory by the President of the Royal Society and Board of Visitors took place on Saturday, June 1, 1850. By the Report of the Astronomer-Royal to the Visitors, we find that but little change has been made in working the Observatory since the last visitation. The instruments are stated to be in excellent order. The large Transit Circle is nearly finished, and is expected to be mounted in a short time. The general plan of meridional observations has undergone no alteration. A general Catalogue of Stars down to the fourth magnitude, as taken from the Catalogue of the British Association, has been in hand for observation since November last. Other stars observed are—stars culminating with the moon, occultation stars, stars in the list for comparison with Mars, and stars insufficiently observed in former years. The bodies of the solar system are observed at every practicable opportunity; with no other exception than these,—that the moon only is observed on Sundays, and that on one day in each month (about the time of new moon) nothing but the stars necessary for keeping up clock error are observed.

The magnetical and meteorological instruments remain unchanged, except by the introduction of the light of coal-gas charged with the vapour of coal-naphtha, for photographic self-registration both of the magnetic and of the meteorological instruments. This light is perfectly efficient for photographic purposes (its photogenic intensity being as nearly at possible the same as that of camphine, or perhaps superior to it); and the lamps continue burning for many weeks without extinction, and almost without requiring adjustment. The chemical treatment of the paper is now so well understood by the assistants, that a failure is almost unknown. Generally speaking, the photographs are most beautiful, and give conceptions of the continual disturbances in terrestrial magnetism which it would be impossible to acquire from eye-observation. It is worthy of remark, that no difficulty is found in maintaining the photographic system

through Sunday as well as through the other days of the week without requiring any lengthened attendance of the assistants on that day. The photographic sheets are taken from the cylinders, and are placed in a dark closet (fresh sheets being substituted), and it is found that the operation of bringing out the impression can with perfect safety be delayed till Monday.—*Athenæum*, No. 1180.

SUPPOSED NEW RING OF THE PLANET SATURN.

Professor Bond, of Cambridge, U.S., is understood to have ascertained the existence of a faint ring of the planet Saturn, interior to the closest of the bright ones. An unusual appearance has been remarked by several astronomers in the possession of powerful telescopes in this country, and is described as faint illumination of a portion of the space between the interior bright ring and the ball, tolerably well defined on the side next the globe, but apparently fading off gradually from the edge of the ring. It is only seen with high magnifying powers and a practised eye. Professor Bond has suspected the existence of another ring for some time past, and was enabled to verify it on the night of November 15th, which was unusually fine. The outer ring has been known to consist of at least two nearly concentric circles for some years past.

THE LUNAR SURFACE, AND ITS RELATION TO THAT OF THE EARTH.

Mr. Nasmyth has read to the British Association the following valuable communication. The subject was illustrated by a series of drawings which the writer has executed by the aid of a powerful telescope, which he has made for himself for the express purpose of following up his investigations on the subject in question. These appear from the drawings exhibited and the descriptions given by Mr. Nasmyth to afford striking illustrations of the nature and action of some of those agencies which in remote periods of the Earth's geological history has given to its surface many of its most remarkable features; namely, as to the causes of volcanic action, the protrusion of igneous rocks, the upheaving of mountain ranges, as well as the submersion of extensive portions of the Earth's surface,—all of which vast geological phenomena Mr. Nasmyth appears to assign to a few grand and simple prime causes, resulting from the consolidation and alternate contraction of the crust and interior of the Earth and Moon—both of which planets appear to have originally been in a molten condition.

After drawing attention to the vast number and magnitude of crater-formed mountains with which every portion of the Moon's surface appears to be covered, Mr. Nasmyth proceeded to give the reasons for the conclusion, that these crater-formed mountains are really the craters of extinct lunar volcanoes; pointing out the frequent occurrence of the central cone, the result of the last eruptive efforts of an expiring volcano, a feature so familiar to all those who have observed volcanic craters on the Earth's surface. This central cone Mr. Nasmyth showed to exist in the majority of the lunar

craters; and thereby drew the conclusion, that they were the result of the same kind of action which has produced them on the volcanoes of the Earth. The cause of the vast numbers of such volcanic mountains with which the lunar surface is bespattered was next considered, and traced to the rapid consolidation and contraction of the crust of the Moon; whose mass or bulk being only $\frac{1}{64}$ of that of the Earth, while its surface is the $\frac{1}{16}$, has, in consequence of these proportions, a radiating or heat-dispensing surface four times greater than that of the Earth in relation to its bulk. From this geometrical consideration Mr. Nasmyth explained how it was that by the rapid cooling and collapse of the crust of the Moon on its molten interior, the fluid matter under the solid crust was by this "hide-binding" action forced to find an escape through the superincumbent solid crust, and come forth in those vast volcanic actions which in some remote period of time have covered its surface with those myriads of craters and volcanic features that give to its surface its remarkable character. The cause of the vast magnitude of the lunar craters was next alluded to; and assigned, as in the former case, to the rapid and energetic collapse of the Moon's crust on its yet molten interior,—the action as regards *the wide dispersion* of the ejected matter being enhanced by the *lightness* of the erupted matter, seeing that the force of gravity which gives the quality of *weight* to matter on the Moon as on the Earth is so very much less on the surface of the Moon than on the Earth,—so that the collapse action had to operate on material probably not half the weight of cork, bulk for bulk. The causes of those vast ranges of mountains seen on the Moon's surface was then touched on; and Mr. Nasmyth endeavoured to explain them by the continued progress of the collapse action of the solid crust of the Moon crushing down or following the contracting molten interior, which by the gradual dispersion of its heat would retreat from contact with the interior of the solid crust, and permit the crust to crush down and so force that portion of the original surface *out of the way*, and in consequence of this action assume the form and arrangement of mountain ranges. Mr. Nasmyth, in illustration of this important action, adduced the familiar case of the wrinkling of the surface of an apple, by reason of the contraction of the interior and the inability of the *surface* to accommodate itself to the change otherwise.

The mountain ranges in question Mr. Nasmyth considers to be nothing more or less than the material which in the original expanded globes formed the comparatively level crust of the Moon and Earth. The fall of the unsupported crust on the retreating nucleus resulting in a tremendous splash on the subjacent molten mass, was described to yield a very probable explanation of the appearance of granitic and igneous centres of certain mountain ranges, as well as the injection of igneous rocks in the form of trap dykes and basaltic formations, which appear to have come forth in this manner from below the crust of the Earth and overlay formations of comparatively very recent formation. The origin or cause of those bright

lines which radiate from certain volcanic centres on the Moon's surface (Tycho, for instance) was alluded to, and illustrated by a very striking experiment of causing the surface of a globe of glass filled with water to collapse on the fluid interior by rapidly contracting the surface while the water had no means of escape. The result was the splitting or cracking up of the surface of the globe in a multitude of radiating cracks, which bear the most remarkable similarity to those on the Moon. Mr. Nasmyth further illustrated this subject by reference to the manner in which the surface of a frozen pond may be made to crack by pressure from underneath,—so yielding radiating cracks from the centre of convergence, the chief discharge of water will take place, while simultaneously all along the lines of radiating cracks the water will make its appearance :—thus explaining how it is that the molten material, which had in like manner been under the surface of the Moon during that period of its history, came forth simultaneously up through the course of the cracks, and appeared on the surface as basaltic or igneous overflow, irrespective of surface inequalities.

This communication was considered so important that, at the special request of the President and other officers of the Association, it was repeated at the Evening Meeting of the Association.—*Athenæum*, No. 1190.

AQUEOUS VAPOUR IN THE ATMOSPHERE.

MR. T. HOPKINS has communicated to the British Association, a paper " On the Means of Computing the Quantities of Aqueous Vapour in the Atmosphere at various Places and Heights." The author stated that meteorologists usually estimated the total amount of vapour in a vertical column of the atmosphere from the dew point at its base, from which they inferred its tension, and thence the total quantity. This he asserted was an erroneous method, as it neglected the effort of the vapour expanding and forcing itself upwards through the air, a colder medium than would exist in each successive foot if nothing but the vapour were present. This opinion he illustrated by diagrams.

ON OPTICAL PHENOMENA IN ASTRONOMY.

THE Rev. Prof. Baden Powell has read to the Royal Institution, a paper "on Optical Phenomena in Astronomy." All astronomical phenomena are in some sense optical; but those referred to in the present instance are peculiar phenomena presented to the astronomer, the causes or nature of which are as yet imperfectly understood. The phenomena referred to are briefly the following :—1. The enlargement of the discs of the sun, moon, and planets, giving apparent diameters greater than the true, but subject to considerable variations under different circumstances ; the most obvious cases of the kind being such as the enlargement of the bright part, and the appearance of the fixed stars in some telescopes with defined circular edges. 2. The formation of the "heads" and "threads" at the

junction of the limbs of the sun and moon in an annular eclipse; and the analogous formation of a neck in transits of Mercury or Venus. 3. The appearance of a bright central spot on the dark side of Mercury in a transit. 4. The apparent projection of stars, at occultations, both upon the bright and dark limbs of the moon; and a similar appearance of Jupiter's satellites on his disc. 5. The formation of a luminous ring round the moon in a total solar eclipse. —Before any optical explanation can be inquired into, it is necessary to bear in mind that many of these phenomena are described as seen only on some occasions, and not on others, even under conditions apparently the same. This seems to point to some personal or ocular cause, whose conditions are unknown, as at least influencing the results. Again, aome of these results have been referred to the action of atmospheric causes, such as extraordinary refractions, &c. taking place in our atmosphere or in atmospheres supposed to be attached to the moon or planets. But, apart from these considerations, it appears that known optical causes might abstractedly account for many phenomena like those described. Theory shows that if the aperture of a telescope be contracted (within certain limits of ratio to its focal length) it will give the image of a luminous point, as a disc, and, if the light be strong enough, surrounded by rings. This principle has been called "the diffraction of the object-glass," and fully investigated by Mr. Airy (*Cambridge Transactions*, vol. v., p. 288): it agrees exactly with the phenomena presented by the stars and by artificial light.

The effect of "irradiation," or the apparent enlargement of a bright object on a dark ground, has been established and elucidated by a succession of researches, from those of Galileo down to those of M. Plateau. It has often been regarded as of a purely optical and physiological nature. Though some part of the effect may be ocular, the author of this communication has shown that the main part of it, at least, is not so, since the same effect is exhibited in an *artificial eye*, or camera obscura. It is increased by increasing the intensity of the light and by contraction of the aperture; and may be identified with the last-mentioned effect, in the telescope the lens of the eye being regarded as an object-glass. Photographic images are also obtained exhibiting the enlargement. This explains the enlargement of discs; and, in conjunction with the curious fact of the rapid increase in intensity of light in the sun's disc, from the edge inwards, accounts for the enlargement and elongation of the small patches of light formed by irregularities in the moon's edge in contact with the sun's limb into beads and threads, and the neck in transits. The enlargement of the moon's disc over a star in contact with its edge would cause the appearance of projection. Instrumental conditions might cause it to be seen in some telescopes and not in others. The same theoretical principle (viz. the diffraction of the object-glass) would give the image a small dark disc on a bright ground with an internal ring or central bright spot. This would explain the spot on Mercury in the transit, had it not been

in some instances described as excentric, and, in one case, double.—For details of investigations on all these points, *vide* Rev. Baden Powell's paper "On Irradiation," in the *Memoirs* of the Royal Astronomical Society, vol. xviii.

But besides these known optical causes, there is another property of light which may bear on the questions, as yet hardly understood. It was originally stated very briefly and imperfectly both by Hooke and Newton about the same time—(see Hooke's *Posthumous Works*, London, 1795, pp. 186 and 190, and the plate 11, p. 155, Newton's "Optics," edition 1721, book iii., part 1, observation 5). This property consists in an extraordinary *divergence of light into the shadow*, which seems to have been unattended to till Prof. Powell devised a more convenient way of exhibiting it, and found not only rays diverging into the shadow of an opaque disc in a remarkably distinct manner, but even when the area of the rays is considerably less than that of the disc, giving the apparently paradoxical effect of a luminous ring *outside* the edge of the dark disc. This seems to explain the luminous ring in a total eclipse, and a modification of the same experiment gives an appearance which may resemble the projection of a star on the *dark* limb of the moon. (See paper by Prof. Powell "On Luminous Rings round Shadows," *Mem. R. Astr. Soc.* Vol. XVI.)

On the whole, phenomena of the class alluded to seem to deserve more special and systematic examination than has hitherto been bestowed on them, and the attention of theorists is particularly invited to the explanation of the phenomena of the ring formed where no distinct rays can reach, especially in connexion with a theory of a somewhat allied case proposed by M. Babinet, dependent on the principle called "the mutual destruction of secondary waves," which in this instance is prevented taking effect by stopping one of the waves. Of all parts of the subject of light, as connected with astronomy, perhaps the most inexplicable is the simple fact of its uninterrupted propagation through such inconceivably vast regions; yet the most exact observations on the aberration of light (which essentially depends on the uniform velocity with which it moves compared with the velocity of the earth in its orbit), show it to be absolutely the same for the nearest planets and the most distant stars and nebulæ, and for those of all colours and magnitudes. These considerations powerfully exalt our ideas of the exactness and uniformity of those laws by which the transmission of light takes place; and, being continued through such enormous and incalculable distances, by excessively minute movements or vibrations with such unchangeable regularity, we cannot but regard it as affording an astonishing confirmation of our convictions of the indications of a Supreme Intelligence.—*Athenæum*, No. 1176.

METEOROLOGY OF 1850.

Results deduced from the Meteorological Register kept at the Royal Observatory, Greenwich, during the year 1850, *under the Superintendence of the Astronomer-Royal.*

1850. Months.	Mean Reading of Barom. Corrected and Reduced to 32° Fahr.	Mean Tension of Vapour, or Amount of Water mixed with the Air.	Mean Pressure of Dry Air.	Temperature of Air. Mean.	High-est.	Lowest.	Monthly Range.	Highest by Day.	Lowest by Night	Mean Daily Range.	Temperature of Evap.	Evap. below Air.	Dew Point below Air.	Dew Point.	Rain. No. of Days.	Amount Fallen.	Weight of Vapor in a Cubic Foot of Air.	Add. Wt. required to saturate a Cub. Foot of Air.	Degree of Humidity.	Weight of a Cubic Foot of Air.
	In.	In.	In.	°	°	°	°	°	°	°	°	°	°	°		Ins.	Gr.	Gr.		Gr.
Jan. ..	29·854	0·182	22.672	33·7	53·1	22·0	31·1	38·0	29·5	8·5	32·5	1·2	4·2	29·5	9	1·2	2·2	0·6	0·897	557
Feb. ..	29·828	0·257	29·571	44·7	58·2	30·0	28·2	50·7	39·1	11·6	42·3	2·4	5.5	39·2	11	1·3	3·0	0·5	0·830	544
March.	30·039	0·204	29·835	39·9	58·0	20·0	38·0	48·6	32·1	16·4	37·0	2·9	7 2	32·7	5	0·3	2·4	0·7	0·770	553
April..	29·594	0·281	29·313	48·5	66·9	34·0	32·9	58·5	42·5	16·0	45·4	3·1	6·8	41·7	15	2·3	3·2	0·5	0·795	535
May ..	29·714	0·298	29·416	51·3	76·5	31·7	44·8	62·1	43·2	18·9	47·5	3·8	7·9	43·4	15	2·4	3·4	1·5	0·765	534
June..	29·886	0·375	29·511	60·8	85·1	36·2	48·9	74·1	48·1	26·0	54·8	6·0	10·7	50·1	20	0·9	4·2	1·6	0·702	527
July ..	29·789	0·496	29·293	62·2	87·0	43 5	43·5	72·9	52·9	20·0	58·4	3·8	6·4	55·8	10	2·9	5·5	1·7	0·881	524
Aug...	29·787	0·425	29·362	60·2	79·0	40·0	39·0	70·6	52·0	18·6	56·6	3·6	7.1	53·1	16	1·9	4·8	1·8	0·807	525
Sept...	29·930	0·345	29·585	56·4	70·5	39·0	31·5	65·3	48·2	17·1	52·9	3·5	8·7	47·7	11	1·3	3·9	1·3	0·750	532
Oct. ..	29·681	0·276	29·405	47·0	64·5	31·5	33·0	53 8	39·6	14·2	44·4	2·6	5·8	41·2	12	1·4	3·2	0·8	0·820	538
Nov...	29·728	0·283	29·445	46·5	60·5	27·9	32·6	52·4	41·0	11·4	44·5	2·0	4·5	42·0	8	2 5	3·3	0·5	0·857	540
Dec. ..	29·914	0·249	29·665	40·6	56·5	24·2	32·3	44·8	36·1	8·7	39·6	1·0	2·3	38·3	12	1·3	2·9	0·3	0·920	550

The cistern of the barometer is 159 feet above the mean level of the sea, and its readings are coincident with those of the Royal Society's flint-glass standard barometer. The observations at Greenwich are taken daily at 9 A.M. noon, 3 P.M., and 9 P.M.; the means of these readings are corrected for diurnal ranges by the application of Mr. Glaisher's corrections as published in the *Philosophical Transactions*, Part I., 1848, and from the readings of the dry and wet bulb thermometers, thus reduced and corrected, the several hygrometrical deductions in the last four columns are calculated by means of Mr. Glaisher's Hygrometrical Tables.

The numbers in column 2 show the mean reading of the barometer every month, or the mean length of a column of mercury whose weight balanced the whole weight of a column of air and water, of the same base; the numbers in columns 3 and 4 show the separate lengths of the mercury balanced by the water mixed with the air, and by the air itself alone respectively.

The numbers in column 5 show the average temperature of the air every month; those in columns 6 and 7 shew respectively the highest and lowest temperature in each month; in column 8 the extreme range of temperature per month is shown; columns 9 and 10 show the averages of the highest temperature by day, and of the lowest by night respectively, and column 11 shows the average daily range of temperature in every month; the headings of the remaining columns sufficiently explain themselves.

The mean reading of the barometer for the year was 29·812 inches; the mean length of the column of mercury supported by the water mixed with the air was 0·306 inches. The mean temperature of the air for the year was

Obituary List

OF PERSONS EMINENT IN SCIENCE OR ART. 1850.

JOHN CALDECOTT, Astronomer to His Highness the Rajah of Travancore.

LIEUT. WAGHORN, R.N., establisher of the Overland Route to India.

SIR FELIX BOOTH, Bart., the munificent patron of Polar Discovery.

DR. PRUS, of the French Academy of Medicine.

J. C. SCHADOW, the oldest of the living sculptors of Germany, professor o the Academy of the Fine Arts in Berlin since 1788.

BIOT, the celebrated French Oriental scholar.

DR. WILLIAM PROUT, the well-known physician, author of one of the Bridgewater Treatises.

M. BEER, known by his works on "Selenography," and his observations on the planet Mars.

ETIENNE BOUCHARDY, the eminent miniature painter.

BROC, the painter, one of the most remarkable artists of the school of David.

MR. GLOVER, the landscape painter.

MULARD, the painter, professor of drawing at the manufactory of the Gobelins.

LUIGHI ZANDOMENEGHI, the Venetian sculptor.

THE REV. WILLIAM KIRBY, "the father of Entomology in Britain."

MR. ROBERT STEVENSON, the eminent civil engineer, who designed and executed the Bell Rock Lighthouse.

SIR MARTIN ARCHER SHEA, president and senior member of the Royal Academy.

JAMES SMITH, of Deanston, the eminent agriculturist.

CHARLES ROTTMAN, the distinguished Bavarian painter.

DR. MEDIEUS, professor of botany at Munich.

WILLIAM BARRAUD, the artist.

CH. SCHORN, the celebrated Bavarian painter.

M. DUBOIS, French architect.

LOUIS MARVY, landscape painter and eminent engraver.

ALEXANDRE FRAGONARD, painter and sculptor.

C. HULLMANDEL, the scientific lithographer.

MORITZ, the well-known Dutch painter.

WILLIAM STURGEON, electrician.

MR. ABRAHAM, the architect.

MR. RITCHIE, the sculptor, of Edinburgh.

JAMES THOM, sculptor.

M. DE BLAINVILLE, member of the Academy of Sciences in its Section of Anatomy and Zoology, and the successor of Cuvier in the chair of Comparative Anatomy at the Museum of Natural History in Paris.

M. GAY-LUSSAC, illustrious by his labours in the physical and chemical sciences.

M. P. SOUYET, chemist.

R. J. WYATT, sculptor.

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